THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XIX. No. 463—22ND YEAR.] LONDON, JULY 5, 1870. [Subscription { 15s. in Advance. / 18s. Credit.] DOUBLE No. Price 1s.

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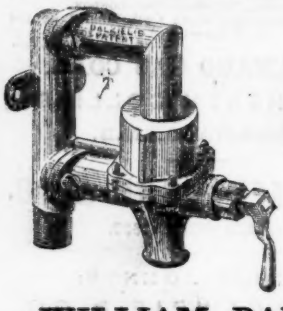

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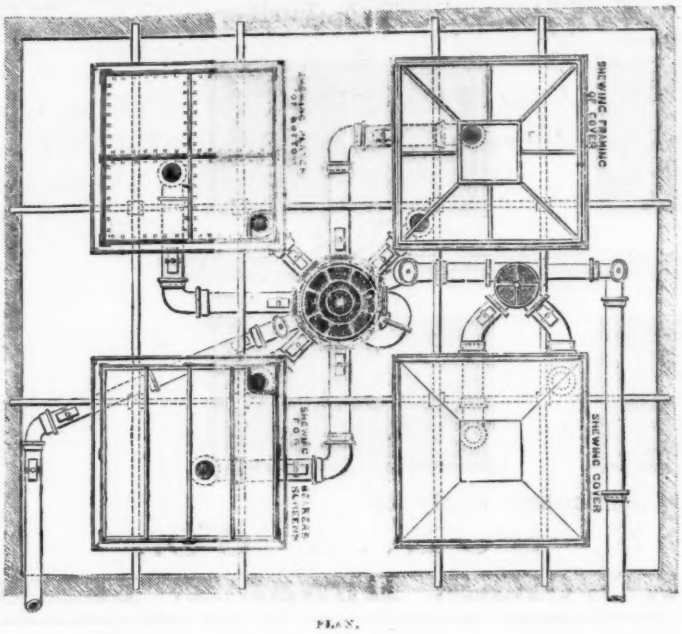
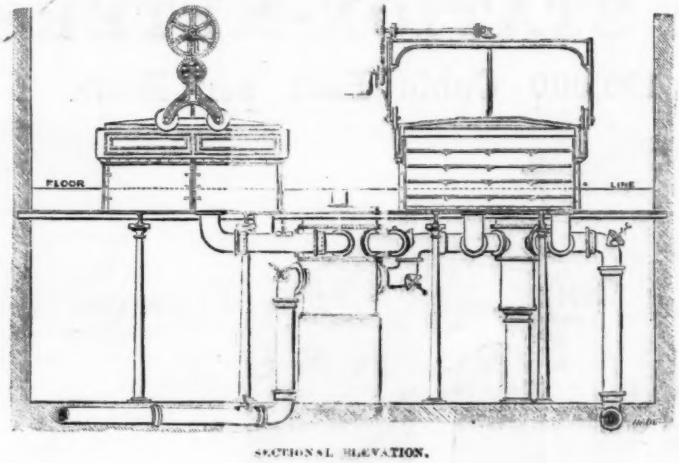


PLAN.



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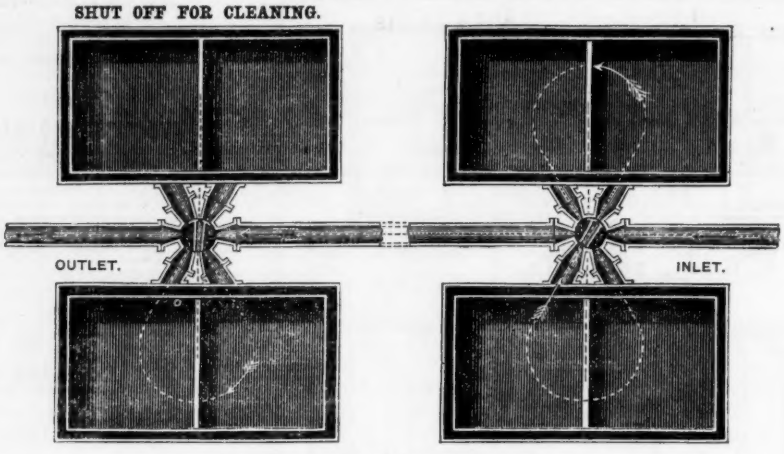

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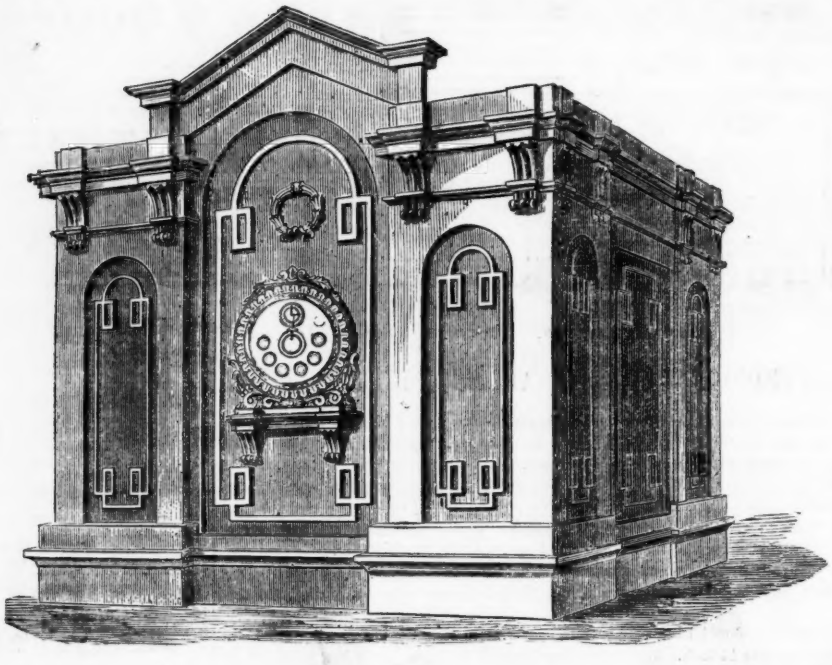

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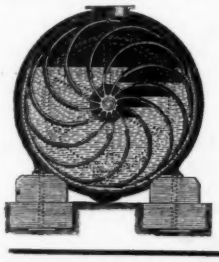

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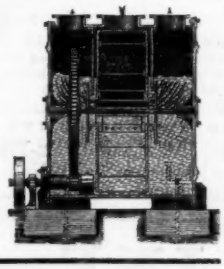

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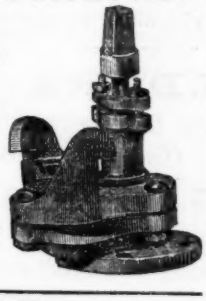

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Plans, Specifications, and Estimates prepared.

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J. SUGG and CO., late ALBERT KELLER, GHENT.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Messrs. Sugg, of Ghent, beg to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by them. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.

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CATHELS'S Patent District Dry Gas- GOVERNOR is the only perfect self-acting contrivance for Regulating the Pressures in the higher levels of a district.

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HYDRATED PEROXIDE OF IRON (BOG OCHRE),

Same quality as supplied by us to several of the most extensive Gas Companies, and which has given entire satisfaction.

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Beg to inform Gas and Water Companies and the public, that they keep in stock in London all the CASTINGS in general use in Gas and Water Works, including Iron Retorts, Socket and Flange Pipes, Bends, Branches, and Syphons of all sizes, Lamp Columns, &c., &c.

N.B.—Orders for Cast-Iron Tanks, Girders, Columns, Cylinders, and all irregular castings, will have immediate attention.

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CELEBRATED SILKSTONE GAS COALS.

Analyses by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

Description.	Cubic Feet of Gas per Ton of Coals.	Illuminating Power in Candles.	Coke per Ton of Coal used. Cwt.	Ash in Coke per Cent.	Sulphur in Coal per Cent.
Best Silkstone . .	10,900	17·0	12·8	2·6	1·7
Norfolk Silkstone . .	11,000	15·94	12·5	4·4	1·64
Silkstone Brights . .	11,500	14·5	12·6	7·4	1·85
Silkstone Nuts . .	10,800	15·85	12·66	6·0	0·69

NOTE.—The illuminating power of the Gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

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W. INGHAM and SONS, having for many years been extensively engaged in the Manufacture of

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beg to call especial attention to their RETORTS, which have for many seasons proved to be unsurpassed in quality by any in the Kingdom, their FREEDOM FROM CRACKS and the ADHESION OF CARBON rendering them worthy the attention of all parties interested in the making of Gas.

The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

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A large Stock of Fire-Bricks, Fire-Clay, Terra Cotta, and Drain-Pipes of all Sizes kept in London at Mr. ALFRED WILLIAMS, Wharf, 64, Bankside, Southwark, where all particulars of Prices, &c., may be obtained.

N.B.—*Export orders continue to have prompt attention.*

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(Established Thirty years,)

Respectfully tenders her thanks to those friends who have patronized her since her late husband's death, and having secured an efficient staff for each department of design and manufacture, she refers with confidence to works recently erected by her as a guarantee that all orders she may be favoured with will be completed in a sound and satisfactory manner.

GASHOLDERS AND TANKS,

Retorts, Retort-Fittings, Condensers, Scrubbers, Purifiers, Station-Meters, Governors, Sluice-Valves of all kinds. (Gas and Water Mains always in stock.)

GAS-FITTINGS,

Including Chandeliers, Pendants, Hall Lamps, Brackets, Star and Sun Lights of all designs, embracing the Mediæval and other periods.

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Combining the most recent improvements in principle and manufacture; upwards of 150,000 already in work, giving the highest satisfaction. (A guarantee for five years given with each one.)

Every description of **Plumbers Work**, comprising **Water-Closets, Beer-Engines, Lift and Force Pumps, Cocks for Gas, Water, or Steam, &c.**

Drawings, Specifications, and Estimates of **Gas-Works, Iron Roofs, Bridges**, and light or heavy structures in wrought or cast iron, supplied on application.

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ENGINEERS, MACHINERY AGENTS, AND MANUFACTURERS,

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And BIRMINGHAM (TANGYE BROTHERS), CORNWALL WORKS, SOHO.

SOLE MAKERS OF

MORTON'S PATENT SELF-SEALING RETORT-LIDS.

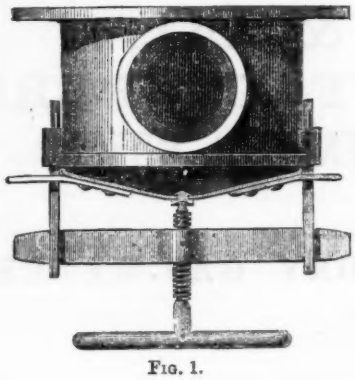

FIG. 1.

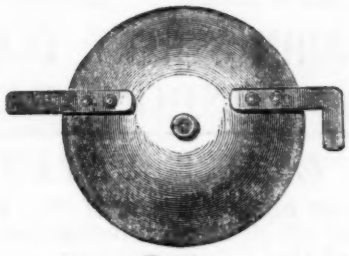

FIG. 2.

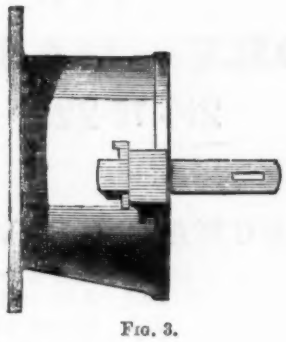

FIG. 3.

Several Hundreds in successful operation in various Gas-Works.

The expensive and cumbersome process of sealing the mouths of Gas-Retorts by means of luting the Lids with lime and other materials hitherto used for that purpose, is henceforth rendered unnecessary, and will be superseded by the very efficient method shown in the accompanying illustrations.

Fig. 1 shows a plan of a mouthpiece with Morton's Patent Lid in section. The mouthpiece is faced true, and the projecting circular edge or periphery of the lid is also turned true, and, by preference, of a semicircular section, so that the point of contact is reduced to a minimum; the convex form of the Lid rigidly sustains the force of the screw, which, by its central action, gives the Lid a uniform bearing, and effectually seals the mouth of the Retort.

Fig. 2 shows a front view of Morton's Patent Lid, which is stamped out of plate iron, having (in this case) ledges to rest on the lugs of the mouthpiece; these Lids, however, are more generally fitted to hinged cross-bars, by which means they remain suspended while the charge is withdrawn and the Retort charged, so that the damage done by throwing them about is entirely prevented.

The advantages obtained are—

1st. The sound sealing of the Retort during the whole time it is carbonizing the charge of coal, there being no jointing medium between the Lid and the mouthpiece.
2nd. The improved condition of the coke by the non-mixture of lime.
3rd. The Lid requires no preparation on the part of the stoker, beyond slightly scraping the surface to remove extraneous grit or dirt.
4th. The Lids are only about two-thirds the weight of the old form in general use, a Lid for a 16-inch mouthpiece weighing a little over 20 lbs.
5th. The Self-sealing Lid reduces labour, saves wear and tear, obviates all the inconvenience and discomfort consequent on the preparation of luting, and effects a great reduction in the working expenses. The cost attending the process of "luting" in several large gas-works, exceeds £1000 per annum, ranging in various works from 20s. to 35s. per mouthpiece.

It will be obvious that a round Lid is the most convenient and the cheapest form. D Retorts are adapted for round Lids, by carrying the bottoms down the necessary depth for that purpose, as shown in Fig 3. Some mouthpieces have been thus adapted, and are in use at the Chartered Gas-Works.

The following testimony speaks in favourable terms after ample and careful test:—

Burslem and Tunstall Gas Company, Longport, Staffordshire, Oct. 12, 1869.

Dear Sir,—In reply to your favour of the 9th inst., I have pleasure in stating that my admiration for your Patent Retort-Lid is most unqualified. I have 14 of them in use, and have tested them in the severest manner possible at these works, but without being able to detect the slightest defect. Yesterday the strap slipped off the exhauster, and a pressure of 13 inches was thus almost instantly thrown upon the Retorts, but although many of the luted Lids were leaking, not the slightest escape was observable from yours. I had anticipated that at least some greater degree of care would have been required in the scraping of the mouthpieces after the drawing of each charge, but even in this particular I find that labour has been reduced.

By every stoker on these works, as well as by myself, your Lids are regarded as a boon.

Please send me 30 more at your earliest convenience.

I am, &c., (Signed) HENRY WOODALL.

R. Morton, Esq.

Chartered Gas Company, Horseferry Road, Westminster, Sept. 15, 1869.

Dear Sir,—I have only lately returned to town, which is the reason I have not replied earlier to your inquiry.

I beg to say that I have had your Lids in use for upwards of two months, and during that time they have always kept a perfectly sound joint. I may add that where your lids are used only one set is required.

I remain, &c., (Signed) G. O. TREWBY.

R. Morton, Esq.

Chartered Gas Company, 146, *Goswell Street, E.C., Oct.* 20, 1869.

Dear Sir,—I have much pleasure in stating that, after some months trial of your Retort-Lids, I find them everything I could desire. I consider the plan a great improvement.

I am, dear sir, yours truly, (Signed) A. UPWARD.

R. Morton, Esq., London Gas Company.

These Lids are in successful use at the London Gas-Works, the Chartered Gas-Works, the Dublin Gas-Works, the Burslem and other Works, giving great satisfaction.

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London, 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865. Paris, 1867.

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PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

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2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

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STATION-METERS AND GOVERNORS,

PRESSURE REGISTERS, GAUGES,

EXPERIMENTAL METERS, PHOTOMETERS, GASHOLDERS, &c., &c.

WATER METERS.

W. P. & Co. beg to state that they are now prepared to supply Station-Meters with planed joints.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

NOTICES.

The subscription to the JOURNAL is 15s. per annum, if paid in advance during the month of January, or 18s. credit, in two sums of 9s. each, in July and January of each year. Post-Office orders should be made payable at the Money-Order Office, London, to William B. King, 11, Bolt Court, Fleet Street, by whom the business department of the JOURNAL is conducted.

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THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 5, 1870.

Notes upon Passing Events.

TOTTENHAM, to the traveller towards London, is a long dreary continuation of Edmonton, situated in as flat and uninteresting a country as it is possible to look upon. It is not mentioned in John Gilpin's ride, because the name would not suit the verse, although John must have passed through it several times. Unpromising as is the appearance of this long village, it once contained mansions, and still has very good houses and gardens. The glory departed from Tottenham with the fashion that swept rich merchants and great bankers westward, amalgamating the dwellings of the Court with the City; but it retains a character of more than average intelligence, which was the privilege of Quakers and Dissenters of the last generation, before the repeal of all parliamentary disabilities destroyed the coherence of a persecuted people. Tottenham was one of the first suburban villages in which the sanitary theories, now universally accepted, took root. It was one of the early districts which formed a Local Board of Health, and tried to establish drains, sewers, and water supply for all the inhabitants on a uniform and comprehensive plan. The people of Tottenham were one of the first victims of the theory that a solid manure, of commercial value, could be manufactured out of the sewage which so much pains had been taken to make liquid. The Tottenham manure manufactory was a failure. Public necessity, embodied in an Act of Parliament, made it unlawful to get rid of Tottenham sewage by polluting the river Lea. The Lea Conservancy Act was passed in 1868; in January, 1869, a committee of three, with a surveyor, was appointed "to report upon the best means of dealing with the sewage of the district, having regard to the "requirements of the Act of Parliament." We have the report of the majority of the committee (two and the surveyor), and the protest of the third, now before us, in the shape of a respectable volume of 150 pages. This report seems to exhaust the whole subject, to travel over much ground that we have often travelled over before, and to open up "fresh fields and pastures new." Finally, the report leaves us in a doubtful frame of mind as to the best mode of treating the sewage of suburban towns, surrounded by land likely to become building land. We find Letheby and Hawksley on one side; Odling, Frankland, and Voelcker on the other.

Who shall decide when doctors disagree?

The report tells us that the Public Health Act was adopted in 1851, and the sewage concentrated to a main outlet into the river Lea. Considerable profits were anticipated from Mr. Higgs's patent lime process. Mr. Higgs erected works at his own expense; the water passed away from the works clear, the solid was packed into bags for sale. After a short trial, the lime process was accepted as a success, and

All went merry as a marriage bell.

The same principle was taken up at Leicester, where about £50,000 was spent in carrying it out. At Tottenham the sales of lime manure first declined, and then ceased; the works did not even pay their working expenses; the patentee and proprietor died, and his executors were glad to resign the contract, with plant and machinery that had cost thousands, for £500. From that time until 1865 the works were carried on by the local authorities, chemists disputing whether the clear water did or did not pollute the river. In 1865 the Conservators of the River Lea obtained an injunction to restrain any increase of the discharge of sewage, and the Act of 1868 absolutely forbade (after the two years of grace) the continuance of the old discharge. The report describes the various disinfecting processes, and amongst others the last and most popular—the "A. B. C." process, which consists in mixing the sewage with large proportions of clay and alum, and small proportions of blood, magnesia, manganate of potash, chloride of sodium, animal charcoal, vegetable charcoal, and magnesian limestone. The process is carried on on a large scale at Leicester. The manure produced is valued by chemists at 13s. 6½d. per ton, but it is actually sold at 1s. a ton! This was the case at Leamington, where the Board of Health has abandoned the idea of filtration and purification, and let the sewage to the Earl of Warwick, who is going into an irrigation farm. In competition with the "A. B. C." is Lenk's, another alum process fully described in an analytical report of Dr. Voelcker, which concludes with these words: "Experience has shown that the "profitable manufacture of portable manure from sewage has yet "to be discovered. Lenk's process simply precipitates organic "fertilizing matter, and, unlike the lime process, introduces into "the deposit no appreciable amount of bulky or useless material." The committee report still less favourably of the iron process, which has been tried at Northampton, and, on a different plan, at Stroud, in Gloucestershire. At Ealing simple filtration was adopted for the purification o sewage, but without success. The committee examined this plan at several other places, and report in great detail against it. Finally, they treat of "purification of "sewage by irrigation," noticing every important place that has adopted this plan, and conclude by recommending it "for adoption at Tottenham." We do not extract from this part of the report, because we have so frequently and fully treated this part of the subject; but we refer those interested in the question to the volume itself. One member of the committee protests against the conclusions arrived at by the surveyor and the other two. He says, "Irrigation is doubtless the proper mode of dealing with sewage where you have scope of land, and that land "away from a populous district—conditions our parish does not "offer. I cannot rely on the calculations of the expense of laying "out a sewage farm. I have no faith in the profits they expect "to get, which must depend on the soil, the weather, and the "seasons. Moreover, the irrigation plan does not relieve us of "our difficulty with the River Lea Conservancy Board, for, supposing it adopted, we should still have four-fifths of our sewage "to clarify before it would be admissible into the Lea. Having "a system that brings nearly all our sewage to the lowest point "of our district, let us treat it there by altering and enlarging "our works so as to take advantage of the experience now "gained in *precipitation* and *filtration*—processes that can be "carried on with certainty as to cost and results." He concludes by recommending an outlay of £4500, expecting no profit, but "the certainty that all nuisances will be got rid of in the most "economical way." For both sides of the sewage question this report may be usefully studied.

The British Association Sewage Committee are doing their best to bring the body with which they profess to be connected into disrepute. They have quarrelled about the application of the £1500 raised in the name of the association, in the distribution of which some of the members protest against applying the rules of the council. These argue that the money never belonged to that body, but was subscribed to enable particular individuals to perform specified work. On this matter we may remark that the original error lay in making use of the name of the association without, so far as we know, any authority from the association. It would have been perfectly right in Messrs. Paul, Wanklyn, and others to advertise independently their willingness to undertake an investigation on the application of sewage; but in that case probably not a pound would have been subscribed. The same thing, however, done in the name of a committee of the British Association has produced £1500, and it certainly does seem hard that this sum should not be applied in the manner originally suggested without disguise. As may be seen by the remarks we made when the subscription was first started, we never had any doubt as to the manner in which it was proposed to divide the fund, and Professor Williamson's objection, if made at all, should have been made at once. The matter will, of course, occupy the attention of the Council at the Liverpool meeting, and we should hope that a strong resolution will be come to, so that this may be the last, as well as the first, occasion on which the name of the British Association was used for distinctly private purposes. In any case we can expect no enlightenment of the subject of sewage from the committee this year, and the subscribing towns must patiently wait for any return for their money.

Dr. Letheby's paper read before the Metropolitan Association of Medical Officers of Health, in May, 1870, on "The Present "Prospects of the Sewage Question in relation to Public Health," in which he treats the Rivers Pollution Commissioners very roughly, has been reprinted. He says: "As for experiments with sewage in "a bottle, they are so absurdly ridiculous, as a means of testing "so important a question, that I am ashamed to refer to them. "The proper way in which such an inquiry should be conducted "is an appeal to the large facts of nature, for everywhere the "rivers of England are receiving the sewage of towns, and yet "they are everywhere undergoing rapid self-purification. If it "were not so we should expect a universal pestilence. We "drink Thames water after it has received the sewage of thousands, "yet it is purer at Hampton, and better adapted to domestic "purposes, than at any part of its course. This has been effected "by oxidation, and the operations of animal and vegetable life."

The South-Eastern Railway Company have incidentally obtained the assent of a committee of the House of Commons to a plan of arbitration which is likely to be carried much further. A clause in the Bill provides that passengers travelling by working men's or *excursion trains*, run at exceptionally low fares, shall not recover for injuries received while travelling in such trains any sum exceeding £100. The amount of compensation to be settled by arbitrators to be appointed by the Board of Trade. It would not be amiss if compensation in all railway accidents and railway expropriations were left to an arbitrator instead of to the lottery of a jury. The other day a dispute between Lord Drogheda and Sir Percy Shelley, about the sale of a yacht, was left to Lord Westbury, described as "equally competent as a yachtsman and a judge of "law and equity." It is absurd to imagine that it can ever answer the purpose of a company to risk a railway accident; but limited liability will greatly increase the number of cheap trains at the hours and at the times most useful to the working classes.

Government telegraphs work so very badly that the cry for Government railways has rather declined. No doubt in the end the clerks will acquire the needful skill, but in the meantime the public suffers. There is another objection to Government management, which has incidentally cropped out, and which would apply still more forcibly to railways owned by the State. Any alteration or addition, requiring the outlay of money, is a terrible stumbling-block in a Government office. At the present time the telegraphic communication between England and Ireland is insufficient. A new cable is wanted. In the case of a private company a cable wanted is supplied in the easiest manner possible. The directors specially summoned would meet, all delighted to have something to do, and to exercise a little patronage. An order would be given to a manufacturer after an hour's discussion, and the thing would be done; but the great head of the Government telegraphs has agonies to go through before he can extract from the Treasury even such a fleabite as ten thousand pounds. He works with a sort of moral halter round his neck, full well knowing that Oliver Twist was not looked upon with more horror by Bumble than the official who asks the Treasury for money. If any one wants to see what the effect would be if the State were to be taxed for every extension of Government railways, he has only to travel round London and see the lines which railway companies are now most unwillingly completing —little branch lines, like that from Walthamstow to Lea Bridge, and from Walthamstow to Broad Street—of enormous convenience to the inhabitants of the suburbs, of enormous value to the owners of building land, but never likely to pay 2 per cent. above working expenses. Look again at the much-persecuted Metropolitan District, boring its way from Victoria Street, Westminster, to Queen Victoria Street, City, under the most painful financial difficulties. Does any sane man believe that any Government would have undertaken, or, if commenced, persisted in so unthankful a job? In Paris, where the great railways are all monopolies protected by the Government for the benefit of the shareholders, the stations are at the most inconvenient distances from the centre of the city. The Emperor, before the wings of his Imperial power were clipped, again and again contemplated an inner circle; he even consulted the great engineer, who is also a great diplomatist, the engineer of the Metropolitan, but the financial difficulty stopped him. The intelligent foreigner who travels from Dover to King's Cross, and on to Leeds, does not care one farthing for the sacrificed shareholders of the London, Chatham, and Dover any more than for the victims of Magenta and Solferino. He looks at results, and blesses the institutions which have pierced London by railways in spite of the thick hide of the Corporation of London. Even that most respectable and slow company, the London and North-Western, left out in the cold by its contempt for the Underground, has been stirred up by the Midland to advance into Euston Road—a small concession to the temper of the times.

A very amusing and instructive little book might be made of the history of taxation in this country since the Peace of 1815. In 1825, Cobbett wrote a letter to the Duke of Buckingham, with tables of the imposts in excise duties levied on every article the farmer and the labourer consumed. When salt, calico, leather, paper, glass, bricks, and candles were all subject to excise—when every sort of imported food was under enormous taxes, and home produced meat, eggs, and honey were almost the only articles free from an impost of some kind—dwellings, clothing, and food all came under the tax-gatherer's protecting and exhausting care. The alteration is not felt, because our wants grow with our supplies, so the present generation never dream, until the figures are put before them, of the burdens under which their fathers groaned—under which they showed what one statesman called "ignorant "impatience of taxation." But another statesman became Chancellor of the Exchequer, who laid down the wholesome principle that taxes should be repealed whenever possible, in order that the money might "fructify in the pockets of the people." This policy was carried further than any office-holder dreamed in 1830 after the Free Trade conquests of 1842. The results are amazing. Between 1840 and 1869 the number of articles subject to import duties has been reduced from over one thousand to sixty-five, and the Customs duties repealed to the amount of nearly twenty-four millions a year; this repeal involving the abolition of the excise on glass, leather, bricks, and candles, and the reduction of that on malt, wine, and spirits. The Customs duties, in spite of the repeal, produce within two millions and a half of the total under the numerous and high duties, while the value of exports of British produce has quadrupled.

In the same way an examination of the true figures of English pauperism dispels the doleful prognostication of political prophets of evil, and cuts away the sad texts of many diatribes by men of much eloquence and more ignorance of practical subjects. A million is a good round number; it is a mouth-filling phrase to declare on a platform that a million paupers are a disgrace to our civilization. The fact is that it is only under the fostering care of the charities of civilization that more than half these paupers are alive. Mr. Göschen has ascertained that out of the million receiving poor-law relief, less than 34,000 are able-bodied men. The whole number of able-bodied paupers is 175,000, and this includes men, women, and children; it includes all claiming temporary relief on account of sickness, also wives deserted by their husbands, and widows until they have found work or married again. It is, therefore, clear that to this phase of distress neither the wild schemes for wholesale emigration at Government expense, nor the still wilder schemes of reclamation of waste lands, would apply. The increase of pauperism is the natural result of a period of depression following a period of inflated speculation accompanied by absurdly high wages. Take one example—the building trade is absolutely stagnant. A few years ago mechanics in the building trade virtually named their own terms, got the highest wages, and did the least possible work. Did the majority of these men profit by their seven, eight, and nine shillings a day? Certainly not. Their expenses and luxuries increased with their wages. Eagerness for office, and a desire to worry political opponents, lead some of our metropolitan members to fawn on and flatter the working man in a manner as mischievous as degrading. To such the explanation of the President of the Poor Law Board were gall and wormwood.

Colonel Henderson is applying himself to improve the Police Force with the zeal which can only be expected from an officer recently appointed. The old commissioner, like the head of every other department, considered that the police had arrived at perfection. Among the important improvements will be the arrangement of districts, in the centre of each of which a policeman will always be stationed, and therefore be as certain to be found as the Fire Brigade man at his post. It will partially and as far as possible remove the complaint that one never knows where on an emergency to look for the policeman, whose duty it is continually to walk on. It is much easier to find fault with the detective force than to make it equal to ideal perfection. The detective, like the poet and cook, is "born, not made." We must rely on some acute chief to continually pick out the best human bloodhounds. All comparisons with continental police, to the detriment of our own, are absurd; there is no parallelism between the position of the two forces. The French policeman is always in the right, and

When he opes his mouth
No dog may bark.

His will is law; he is neither subject to be snubbed by magistrates, nor criticized by newspapers, nor overhauled for indiscretion by his superior officers. The Parisian detectives who arrested and imprisoned the secretary of an English bishop as a pickpocket, for three days, without even allowing him to communicate with his friends, were not even reprimanded. It is easy to bear a high character if no one is permitted to find fault with you. If the vigorous system employed by the French police to hunt out a criminal were introduced here, it would not be borne ten days; a hurricane of newspaper protests would put it down. The great fault in England is, that when we have caught our "hare," the criminal, we take the greatest pains to let him loose again. We hedge him round with the same precautions against conviction as when he was deprived of the assistance of counsel, and had to rely on the judge for common justice. There is no reason why the accused of any criminal offence should not be invited to make a statement, and called on to account for any circumstances of suspicion, before he is committed. Now the innocent are deprived of the benefit of their own evidence, and the guilty have the advantage of technical mystery.

The people of Knightsbridge are very anxious to get rid of the Household Cavalry. The Government are pressed to rebuild the barracks, pronounced thoroughly unhealthy, there or somewhere else. Chelsea has been proposed, and behold! the parishioners of Chelsea have risen in indignation against the notion. They find the pensioners of the hospital and the Foot Guards sufficiently seductive to their female population, and dread the addition of a charge of cavalry. We should have thought that five or six hundred more military Lotharios would have made very little difference to so large a parish, already so truly military. They also object to the loss of rates by the conversion of building-ground into barracks. If that objection were to hold good, every town of England might protest against barracks or a garrison. The protesting parishioners who complained that Government buildings covered so many acres, seemed to forget that it was the hospital that originally made Chelsea important, and the suspension bridge, built, not at the expense of Chelsea, that made the Foot Guards barracks possible. The grievance is not in placing soldiers here or there, as long as it is necessary they should be quartered anywhere, but that three regiments of perfectly useless cavalry should be kept up at one-third more cost than three regiments of ordinary useful heavy dragoons, when a hundred mounted guards would do all the State duties performed by the Household Cavalry, quite as well, and so much more cheaply.

The parish of Islington has now set an example to the metropolis by permanently adopting the steam-roller for all its streets. The result is that a few days after macadamization has been completed the streets are ready for traffic, silent and smooth as a garden walk. The commencement was made as an experiment in the High Street. This was found so satisfactory that the use of the machine was continued for a year, and it is applied to the most insignificant thoroughfares. The steam-roller employed is that of Aveling and Porter, of Rochester. The Metropolitan Board, in their next *omnibus* Act, should make the employment of a steam-roller compulsory.

Circular to Gas Companies.

The progress of the Gas and Water Facilities Bill in the House of Lords has been suspended, and the order for going into committee has been discharged, preparatory, as some persons believed, to the withdrawal of the Bill altogether; but more probably, as we are informed, to allow of further amendments being made, when the committee now sitting on the Tramways Bill shall have made its report. However prejudicial the measure may be to those who profit by the present system of private Bill legislation, they have taken no visible means of opposing it; but it is said that the legal element in the House of Lords views with some dissatisfaction the abdication of their function which the Bill proposes, and it is not impossible that an opposition may spring up at the last stage which may be fatal to the measure. Should, however, the measure pass, the proceedings on the St. Helen's Gas Bill, the last contested gas Bill of the session, will be pointed to as an instance of the abuse to which the present system is liable, in subjecting the promoters of private Bills to unnecessary expense. The Bill promoted by that company for raising additional capital has been opposed by the Corporation of the borough in both Houses of Parliament, and that opposition has entailed upon the company expenses amounting to nearly £3000 in obtaining power to raise an additional share capital of £24,000! The ill-concealed object of the Corporation was evidently to depreciate the value of the property, in order that they might purchase on cheaper terms than they would otherwise be able. The question of the payment of the costs of the Corporation out of borough funds has still to be settled, and will probably be carried to the Court of Queen's Bench in the event of the costs being allowed by the borough auditor.

The Brighton and Hove General Gas Company have succeeded with their Bill before committee. The object of the Bill, as will be remembered, is to obtain compulsory powers to purchase a piece of land for the erection of carbonizing works close to Shoreham Harbour; and it was opposed by some neighbouring proprietors on the singular ground that they had land which they were willing to sell, and which they contended would better answer the purpose of the company. It was further contended that the construction of groynes, to protect the site proposed by the company from the encroachments of the sea, would be detrimental to the interests of the petitioners. The obvious advantages, however, of the site selected, and the fact that the company proposed to do no more in the construction of groynes than it was competent for any foreshore proprietor to do for the protection of his land, satisfied the committee that the opposition was uncalled for, and the Brighton Company may be congratulated on having obtained a site in every way suited to their purpose, and which, in so far as the landing of coals is concerned, offers peculiar advantages.

The death of Mr. C. H. A. Martelli, the chairman of the Equitable Gas Company, which took place at his residence in Westbourne Square, on May 30, after a few days illness, deserves mention in our columns. He first became a director of the Equitable Company in 1855, and on the retirement of Mr. Holdship, in 1866, was elected chairman. He took a very active part in the management of the affairs of his company, and was especially concerned in effecting the arrangements for districting the metropolitan gas companies in 1857, and bore a prominent part in all the parliamentary struggles from that date to the present time. Mr. Martelli was a man of most amiable disposition—kind and courteous at all times to all persons. Sir James Duke, Bart., succeeds him as chairman of the board of directors of the Equitable Gas Company.

The Local Board of Health of Sheerness have commenced a dispute with the Sheppy Gas Company in a very high-handed manner. It is no concern of ours that the Board have made themselves conspicuous by blunders and failures, while the gas company is a well-managed, prosperous undertaking, although this may to some extent account for the proceedings of the Board. The simple facts of the case are these:—At the present time the 133 public lights of Sheerness, each consuming 4½ feet per hour, from sunset to sunrise, for every night of the year, are supplied by the company at the rate of £3 16s. per lamp, which includes the cost of lighting, extinguishing, &c., or about 3s. 2½d. per 1000 feet of gas consumed. The Local Board are of opinion that they ought not to pay more than £3, and they have made what almost amounts to a peremptory demand that the charge be reduced to that sum, with the threat that, in case of refusal, they will erect works of their own. The demand is supported by a comparison of the price for public lamps charged at Rochester and the price at which gas is supplied to Sheerness Dockyard. Unfortunately, however, for the Local Board, these comparisons do not at all help their case. At Rochester and Chatham the public lamps, 391 in number, are contracted for at the rate of £3 per annum, but they burn only 313 nights of the year. If the lamps at Rochester were lighted every night of the year, the proportionate price would be at least £3 10s. per lamp per annum, and it is to be remembered that there are three times the number that there are at Sheerness. The dockyard, which takes six million feet a year, or more than double the quantity consumed by the public lights of Sheerness, is supplied by meter, and the gas is registered directly it enters the dock gate. All the mains and services within the docks belong to Government, who suffer all the loss by leakage (estimated at 20 per

cent.), and the lighting, extinguishing, &c., is done by dockyard *employés*. The gas is charged for at the rate of 3s. per 1000, which may be accepted as fully equivalent to 3s. 9d. per 1000 if distributed with the ordinary risks and responsibilities. So far, then, as we have said, the comparison does not at all assist the Local Board, and it must be allowed that the charge of £3 16s. per lamp is by no means unreasonable for Sheerness. But inasmuch as some years ago, when there were competing companies, only half the present number of lights were supplied at the rate of £2 18s. per annum, the Board have taken it into their heads that they may effect a great saving by manufacturing their own gas—an idea which is supported by some wonderful calculations made for them, to which we shall presently allude. But it would be well for the Board to consider first whether they have any power to erect works. Neither the Public Health Act nor the Local Government Act gives them power to expend money for the purpose, and if they commenced it would be competent for any ratepayer to apply for an injunction to restrain them. Nor has the Home Secretary power to grant a provisional order to authorize any Local Board to raise money for any such undertaking as the erection of gas-works. It is true that a provisional order was once granted to the Stroud Local Board, authorizing them to raise money for the purpose, but this was only because the Local Board were the successors of a body of Improvement Commissioners who had already obtained statutory powers for the erection of works; and even in this case Parliament subsequently refused to confirm the provisional order. There is, then, no prospect of the Board being able to carry out their threat to erect competing works, and it would be far better for them to come at once to some amicable understanding with the company, and either get the price fixed by arbitration, as is provided for by the Gravesend Gas Act, or take the gas by average meter indication as prescribed in the Folkestone Gas Act. That would be a much more sensible course than for the Board to be deluded into the erection of works, if they could obtain the power to do so, by such a report as they have had presented to them on the subject, which, while displaying an utter ignorance of the business of gas-making, shows some incapacity in the writers to work multiplication sums. But the errors made in this way are trifling matters in comparison with the omission in the estimate of any mention of interest on the capital of £5000 it proposes to expend. The saving the Board is led to expect by making their own gas amounts to £247 4s. per annum; but where would the saving be if they raised £5000 at 5 per cent., and had to pay off the capital in 30 years?

We have received a copy of the "Bulletin de la Société Française de l'Industrie du Gaz," a society formed in imitation of the British Association of Gas Managers. The society, which holds its meetings at Lyons, numbers among its members most of the gas managers of the principal towns in the south-east of France, but does not yet appear to have many adherents in other parts of the empire. The objects of the society appear to be the same as those of our own association. Up to this time the proceedings offer nothing of particular interest to us. They include a long paper "On the Obstruction caused in Mains and Services by Naphthaline," which contains but little new to English gas engineers, and that little quite unimportant; and another paper "On the Changes produced by Gas in India-rubber Tubing," which do not much concern gas managers. Another very completely illustrated paper is "On a Plan for Setting Nine Retorts in a Bed," but as it involves the use of retorts of two different sizes, the plan is not likely to find favour in this country. For the rest, the proceedings contain only conversations on matters specially interesting to French engineers, but of no importance to us. There is, however, one regulation to which we may direct the attention of the British Association of Gas Managers as worthy of adoption. At each annual meeting it is decided what subjects shall occupy the attention of the society at the following meeting, so that the members are able to contribute to the discussion the experience gained in twelve months special study and observation.

Correspondence.

GAS-VALVES.

SIR,—I notice in the JOURNAL of last week, in the report of the proceedings of the Association of Gas Managers, from which I was unavoidably absent, that the chairman, in his inaugural address, speaking on the subject of gas-valves, said:

"I hope next session we shall have a paper on valves, and I would draw attention to Messrs. C. and W. Walker's new patent for improvements in centre-valves. . . . . Messrs. Walker are manufacturing the centre-valves for the Beckton works. The centre-valves hitherto made by them were liable to leak, from settlements of naphthaline and dirt upon their surface facings. Some of these deposits were of a slippery nature, so that the valves in turning slid over them instead of throwing them off, and became leaky. Messrs Walker's improvement overcomes this difficulty by means of casting surfaced bars, or covered facings, in the valve, which do not interfere with the passage of the gas, but always cover the surfaced facings of the partitions of the body, thus protecting that part from injury of every kind, and rendering the valve perfectly tight."

Without wishing to detract from the merit of the improvement described by him as introduced by Messrs. Walker, I would remark that the idea, which seems only lately to have struck them, suggested itself to us many years ago, and that every valve made by us since that period has been made with the improvement alluded to—viz., with a surface-bar in the cover corresponding with every segmental division in the body of the valve. We very early discovered that which they have since found out—viz., the injurious effect of the crude gas upon the exposed surfaces of the valve during the time it was at rest.

The model exhibited by us at the Nottingham meeting of the Association is fitted with this surface-bar, as can be seen.

We are the original patentees of this system of valves, and since our patent was enrolled have made upwards of 400 of them. Every season seems more to develop their usefulness, and the great press of orders now on hand is the strongest testimony that can be given of their merit.

HENRY COCKEY.

Iron-Works, Frome Selwood, June 25, 1870.

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, JUNE 20, 1870.

The following Bills received the Royal Assent:—The ECCLESHILL AND BOLTON GAS; DARTMOUTH WATER; PAISLEY GAS; ST. ALBANS GAS; HEBDEN BRIDGE GAS; CARMARTHEN GAS; READING GAS; LEEDS CORPORATION GAS (PURCHASE, &c.); RUABON GAS; SHIPLEY GAS; KIRKCALDY AND DYSART WATER; BUXTON GAS; IMPERIAL CONTINENTAL GAS ASSOCIATION; RAINHILL GAS AND WATER; CLECKHEATON LOCAL BOARD; and CARDIFF GAS.

The BLACKBURN CORPORATION IMPROVEMENT BILL.—Lord Elphinstone was appointed a member of the Select Committee on this Bill, in the place of Lord Saltersford.

TUESDAY, JUNE 21.

The SALFORD BOROUGH IMPROVEMENT BILL.—The opposition to this Bill was withdrawn.

The GREAT CENTRAL GAS CONSUMERS COMPANY'S BILL.—Reported, that the parties do not intend to proceed further with the Bill during the present session.

The SKIPTON WATER BILL, and the GASLIGHT AND COKE COMPANY'S BILL, were reported, with amendments.

THURSDAY, JUNE 23.

The HALIFAX WATER, and the DUBLIN CORPORATION WATER BILLS, were reported, without amendment.

FRIDAY, JUNE 24.

The YEOVIL IMPROVEMENT BILL was read a third time, and passed.

The SKIPTON WATER BILL was read a third time, with the amendments, passed, and sent to the Commons.

The LEEDS CORPORATION GAS, &c, BILL was returned from the Commons, with the amendments agreed to.

MONDAY, JUNE 27.

The HALIFAX WATER, &c., and the DUBLIN CORPORATION WATER BILLS, were read a third time, and passed.

A petition was deposited against the READING LOCAL BOARD OF HEALTH BILL, from the inhabitants of Reading.

TUESDAY, JUNE 28.

The NEWCASTLE AND GATESHEAD WATER BILL was reported, with amendments.

A petition was deposited against the OLDHAM CORPORATION WATER BILL, from the Local Board of Health of Uppermill.

FRIDAY, JULY 1.

The GASLIGHT AND COKE COMPANY'S BILL, and the NEWCASTLE AND GATESHEAD WATER BILL, were read a third time, with amendments, passed, and sent to the Commons.

The BLACKBURN CORPORATION IMPROVEMENT BILL was reported from the Select Committee, with amendments.

The BRIGHTON AND HOVE GENERAL GAS BILL was returned from the Commons, agreed to, with amendments. The said amendments considered, and agreed to.

The SKIPTON WATER BILL was returned from the Commons, with the amendments agreed to.

HOUSE OF COMMONS.

MONDAY, JUNE 20, 1870.

The PUBLIC HEALTH (SCOTLAND) SUPPLEMENTAL BILL was returned, without amendment. (Brechin Provisional Order confirmed.)

WEDNESDAY, JUNE 22.

The BRIGHTON AND HOVE GENERAL GAS BILL was reported.

THURSDAY, JUNE 23.

The LEEDS CORPORATION GAS, &c., BILL.—The Lords amendments were agreed to.

FRIDAY, JUNE 24.

The LITTLEHAMPTON WATER BILL was reported, with amendments.

MONDAY, JUNE 27.

The BRIGHTON AND HOVE GENERAL GAS BILL, as amended, was considered.

TUESDAY, JUNE 28.

The ST. HELEN'S GAS BILL was reported, with amendments.

THURSDAY, JUNE 30.

The SKIPTON WATER BILL.—The Lords amendments were agreed to.

The BRIGHTON AND HOVE GENERAL GAS BILL was read the third time, and passed, with amendments.

FRIDAY, JULY 1.

The LITTLEHAMPTON WATER BILL, as amended, was considered.

The BIRMINGHAM WATER BILL was reported, with amendments.

HOUSE OF COMMONS.

(*Before Mr.* E. Baines, *Chairman; Mr.* Norman Grosvenor, *Mr.* Broadley, *and Mr.* Verner. *Sir* John Duckworth *sat as Referee.*)

BRIGHTON AND HOVE GAS BILL.

MONDAY, JUNE 20.

Mr. Johnson, Q.C., and Mr. Michael appeared for the promoters; Mr. Richards, Q.C., for the petitioners, who are the devisees in trust under the will of Mr. Hugh Ingram.

Mr. Johnson said the bill was entitled "An Act for empowering the Brighton and Hove General Gas Company to construct works at or near New Shoreham Harbour, and to acquire a site for the same and for other purposes," and it had already passed unopposed through the other House. There were at first several petitioning opponents, but they were all satisfied or rejected before the matter came on to be discussed, and the present petitioners withdrew their opposition in the House of Lords on the understanding that the promoters were to make no use of that withdrawal in the future stages of the bill. The company was established in 1825, under a Deed of Settlement, but their area of supply having considerably increased, it was found necessary to apply for parliamentary powers. In 1839, therefore, they obtained an Act of Incorporation to supply some eleven parishes in and about Brighton—viz., Brighton, Hove, Preston, Aldrington, Portslade, Southwick, Kingston, New Shoreham, Patcham, Pyecombe, and Clayton; and under another Act, passed in 1866, two other parishes—Old Shoreham and Lancing—were added. The works were built quite in the western part of Hove, which at that time was entirely removed from all dwellings. A second company, established for supplying some of the same parishes, and incorporated under a similar Deed of Settlement, built their works in the extreme east of Brighton. The authorized share capital of the promoters amounted to £175,000, with borrowing powers of £45,000. In 1866 it became apparent to the promoters that they must seek for further powers, the site of their works being very cramped, and circumscribed in space, and they proposed to acquire additional land, which was very difficult to obtain in that particular district. Immediately afterwards the Aldrington, Hove, and Brighton Gas Company was set on foot in opposition to the two existing companies. That company also came before Parliament, and both bills ultimately passed. In the present promoters bill the compulsory powers of taking the land proposed by the bill of 1866 were struck out; they were limited in price to 3s. 6d., except as regarded the supply of gas to Portslade, in which, being an outlying district, they were allowed to charge a price not exceeding 4s. They were also prohibited from erecting additional works for the manufacture of gas upon their present site, the committee being of opinion that such works should be erected upon land between Shoreham Harbour and the sea. If their Act did not prescribe it, it restricted at all events the power the company had of acquiring lands in any other locality, and they now sought, upon the lands scheduled for the purpose, to obtain a site which was strictly within, if not by prescription, the land indicated, and to which they were restricted by the Act of 1866. It might be taken for all practical purposes that the Aldrington Act was defunct, for there seemed to be no attempt by its promoters up to the present time to revive or keep alive the powers contained under that bill. It was very obvious that Parliament at that time thought there was room for a third company, owing to the increase which had taken place at Brighton in population, buildings, &c., and in the supply of gas that was wanted. The promoters of the Aldrington Bill provisionally contracted for the purchase of a bit of land, which he might say was purchased, because the moving spirit in it was Mr. Ingram, and it was a portion of the very land that was claimed by him. A great contest subsequently arose between Colonel Lloyd and Mr. Ingram about the very land which the petitioners now suggested would be a desirable site for the promoters to have. The lands overlap one another; but the site now proposed to be taken compulsorily and the one which they had provisionally contracted for at that time were to some extent the same, but now a part had been absorbed by the encroachments of the sea. Since the establishment of the present company in 1825, building had gone on from point to point. Brunswick, Queen Adelaide, and Palmyra Squares, Upper and Lower Clifton had been built, and they certainly tended towards the spot where the Hove Gas-Works were in full operation, showing that the gas-works had been no serious obstacle to building up to the present time. But the existing site was wholly inadequate for the purposes of the present company, they did not exceed 3½ acres, and the object of the present bill was to obtain a fresh site in the district indicated by the committee in 1866. They were excluded by the Act of 1866 from going elsewhere than where they were seeking to go under the present bill—viz., upon the sea-beach south of the eastern branch of Shoreham Harbour. The land proposed to be taken was 8 acres or thereabouts in extent, and formed part of the sea-beach lying between the canal or eastern arm of New Shoreham Harbour and the sea, and it was 708 feet in length by 472 feet or thereabouts in breadth. This land was no part of the petitioners land, nor any land over which they had a shadow of a claim. The committee would see in the plan a towing-path, which ran east and west along the margin of the New Shoreham Harbour; it then came to a solid roadway across from north to south, and went along to the eastward. Along that the promoters proposed to lay their pipes or mains. At a certain point it was also proposed to carry the mains across under the bed of the harbour itself. The committee might be aware that along the southern coast the sea was encroaching rapidly, and unless the shore were protected by groynes the inevitable consequence would be that the sea would make its way into Shoreham Harbour, and destroy it. In acquiring this land it was indispensable to protect it from those inroads of the sea, and therefore, under clause 17, the company now sought powers to erect groynes, which were not to be of such a character as to do more than protect the property of the company. They proposed to take this land under compulsory powers, in which there was nothing unusual, and indeed for gas-works it was commonly, though not invariably done. In this case it would be indispensable, because there were many conflicting claimants to the property; so that to acquire this by any other than a parliamentary title would be utterly insecure. The petition of the devisees in trust under the will of Hugh Ingram, against the bill, stated that power was sought to use certain of their lands and a road belonging to them, which had hitherto been a private road, used only for specific purposes, and they objected to such interference with their property. They also stated that the site was ill adapted for the erection of gas-works, and that a better site might be selected which would be exempt from such an objection. With reference to laying a main under the eastern arm of the harbour, the petitioners denied that there was space to lay it effectively above the culvert passing under the road between the Wish Basin and the Wish Pond—the spot shown on the plan. The petitioners also said they were owners of the wharves on the harbour, and that the company proposed to erect a wharf near to this piece of land which would be injurious to their interests. There was no doubt, however, that such a course would be the greatest accommodation possible, not only to the company but to the public; for he was told the present wharves in the harbour were very limited, and there was not really room, for the company had 20,000 tons a year brought up to those wharves at present, and if they had a wharf of their own they would pay no less to the harbour authorities. The company would continue to pay the harbour dues, and the result would be that they would be able to have the vessels alongside their wharf, and convey the coals immediately into the works, instead of occupying space on the existing wharves for the purpose. At present all the coal taken from the harbour for the use of the company was carted along the public highway, but this would be entirely obviated under the provisions of the bill; while, as far as regarded the establishment of wharves, it would not only give them accommodation, but it would not in the remotest degree interfere with the navigation or the water-way up the harbour. As to the petitioners claim that this road belonged to them, he (the learned counsel) was told distinctly that that was not so, that it had been used for public purposes, and that they had no right or claim to it. As far as the harbour was concerned (they being interested as owners of wharves), it was in the hands of the commissioners, who were the proper persons and the custodians, and he would not only show that the commissioners were favourable to the scheme, but he would call the harbour-master in support of the bill. Assuming, for a moment, that this was a private road of the petitioners, what damage would be done to it? Any damage done would be paid for. With regard to the Wish Pond and the Wish Basin, the road went there over a solid roadway, and there was a culvert underneath to connect the Wish Pond with the Wish Basin, and as far as he knew it was utterly unused; but assuming it was useful, the complaint that a main could not be laid there with a due regard to the culvert was the merest myth. From the surface of the road to the top of the culvert was 3 feet, and all that was wanted was to lay a 14-inch main beneath the roadway. In paragraph 6 the petitioners stated they were advised it was impossible to "lay, maintain, repair, alter, and remove" gas-mains in the bed of the harbour on the spot proposed without draining the harbour, and they alleged that even if compensation could be made to them for their loss by drainage, such compensation was not provided for in the bill. He (Mr. Johnson) maintained that it could be done without draining the harbour at all. Such things were done every day. It might be done by coffer-dams, or, if it need be done, it would be done when the harbour was drained, as it occasionally was, for their own purposes. The petition contained the curious suggestion that the company ought to take the petitioners land for the purpose of their new works. Mr. Ingram, the solicitor acting for the petitioners—himself a member of the family claiming the land—was the moving spirit of the rival bill of 1866, and pointed out this particular land for the works of the Aldrington Company. It was stated in the petition that the site chosen by the company in 1866 was in all respects better than that which they now sought to acquire. They objected to it in 1866; they alleged that it was on their property, and that he supposed was the real object of this suggestion. The company tried to negotiate for it before 1866. The petitioners opposed the bill in that year, and now in 1870 they said it was in all respects better, and was what the company ought to adopt. Then they proceeded to say that "the site of 1866 did not involve any interference with the bed and waters of Shoreham Harbour, was nearer to the wharves from which the company must obtain their coal, and was also nearer to the town of Brighton, and did not inflict upon your petitioners the injury of which they now complain." His answer to that was that the site was already partially that of a rival company. Whether their powers were existing now or not he could not say, but a great part of the site had, since the passing of their Act, been absorbed by the sea, and in no degree was it so convenient as the site the promoters proposed to adopt for themselves. With regard to the question of the groynes, the petitioners stated that their construction would materially affect their property, and that no notice of intention to construct them had been given by the company, and that they absolutely objected to the insertion of anything which could imply the right of the company to construct such groynes. They took the same objection before, and so far from its being true, it was utterly fallacious and without any foundation, for the notice ran—"to erect, construct, and maintain groynes and other works on the sea-beach or foreshore," &c. Supposing the company did erect groynes to affect the property of the petitioners, they did no more in erecting such groynes than was the right of every landowner on the sea-shore from end to end of this island. Owners of land had a right to do it, and all the company sought for was to become owners of that property in order that they should have all the rights of ownership. If his learned friend was right that the company had not this power, then the promoters incorporated the Lands Clauses Consolidation Act, and that being so, if the petitioners were injuriously affected by the operations of the company, they had a right to be compensated under that Act. To protect all that property he would prove that groynes must be erected. Mr. Ingram could not protect his own property unless he took that precaution. These were the only petitioners against the bill, and they had no pretence for saying that the land sought to be taken compulsorily was their own. He denied that they had any rights other than were vested in those who were the true custodians of the harbour, but if they had any such rights, they would not in the slightest degree be prejudicially affected by the works which were proposed to be carried out.

TUESDAY, JUNE 21.

Somers Clarke, Esq., examined by Mr. Michael.

I am solicitor to the Brighton and Hove Gas Company, and was concerned for them in the bill of 1866. They then wished to acquire two sites, one in the parish of Hove, adjoining their present works, for which they had entered into a provisional agreement to purchase; the other at Aldrington, which was very nearly the same as that sought for and obtained by the Aldrington Gas Company. The latter company have done nothing since the passing of their Act. The compulsory powers to purchase the land were struck out of our bill, and we were also restricted from erecting additional works at Hove. The site at Aldrington was claimed by Colonel Lloyd and the trustee of Mr. Ingram, upon whom we served parliamentary notices. In consequence of our compulsory powers being struck out, we sought for another site, and obtained a contract with Mr. Elliott for one at Portslade. An abstract of title was furnished by the vendor's solicitors, on investigating which I found that the only title to this beach land was by reference to the tide map, and they sought to show that by the tide map of 1842 this beach land had become a part of their estate. I did not consider this was a satisfactory title, and represented to the solicitors that they must furnish a better one. After a long correspondence, a communication was made to Mr. Statham that he must get the consent of Colonel Carr Lloyd as another claimant to the property. Finding this was not done, the company filed a bill in Chancery against Mr. Elliott for specific performance. After much evidence was given, the bill came before the Master of the Rolls, and it was then sought to introduce parole evidence, that by the contract we were to accept Mr. Elliott's title. After hearing the arguments, the Master of the Rolls offered us specific performance if we would accept the title, but as we could not do that he dismissed the bill. The whole of the land there is claimed by Colonel Lloyd, and there are several other claimants to this piece. I believe it is utterly impossible to negotiate for the purchase. In the great action of *Ingram v. Lloyd*, the ultimate verdict was in favour of Mr. Ingram, and a motion for a new trial was refused. That applied only to the part of the land in Aldrington parish; the part we seek, being in Portslade parish, is not affected by it. I am well acquainted with the position of the land. It is separated from the mainland by the eastern branch of the harbour, and the nearest houses, which are 200 yards off, are of a very small description, many of them unlet, some let by the week, and the largest of them worth only about £20 or £25 a year. The inhabitants petition in favour of the bill. I have been forty years vestry-clerk of Brighton. In 1859 the number of houses rated to the poor was 13,089, in 1869 the number was 14,940, being an increase of 1851 in ten years. In the parish of Hove the number in 1849 was 1196, and in 1859 it was 1453, being an increase of 257; the latter are almost all of a superior class. There has also been a considerable increase in the town of Preston; a new town, called Prestonville, has sprung up. The effect of the sea in the neighbourhood of Brighton is to wash away the beach, so that groynes have to be erected to prevent its destructive action. The intended site of our works is about two miles from the mouth of the harbour, the commissioners of which have erected 35 groynes in that direction, coming up to within half a mile. I am quite sure it will be necessary that we should erect groynes to protect our site. Judging from the past, I should say

that in the course of a few years the sea would break through into the harbour; the groynes are sometimes knocked to pieces by the violence of the sea. I know the road across the harbour, between the Wish Basin and the Wish Pond; it has been used by the public for 15 or 20 years.

Cross-examined by Mr. RICHARDS: Colonel Lloyd claimed, as lord of the manor of Lancing, all that land which was on the left bank of the river Adur. In the course of time the Adur took a sweep eastwards, and so ran parallel to the sea before discharging itself into the sea. Colonel Lloyd claimed what then became the right bank of the Adur as an increment of the manor of Lancing.

Sir JOHN DUCKWORTH: You are touching upon the title to land, with which we have nothing to do. Mr. Johnson only referred to it to show the difficulty of getting any title at all there.

Mr. RICHARDS: Anything more complicated it is impossible to conceive. Colonel Lloyd claims that, inasmuch as this was the work of nature, it belongs to him as an increment of the manor. On the other hand, the persons who owned the land opposite claimed to be entitled to the land all the way down to the sea.

Cross-examination continued: The Ingram family claimed that as being conveyed to them as part of the Aldrington estate. At the trial there was, in the first place, a verdict for Mr. Ingram; that was set aside, and a new trial granted, in which the verdict was still in their favour. The 14th of March last, which was the day on which this bill was before the House of Lords, was the day fixed for the Lewes Assizes, and the petitioners stated that they could not appear in opposition to the bill, having to attend to their business on the trial.

Mr. RICHARDS: The same claim which Colonel Lloyd put forward to the Ingram estate he lays to the land in the parish of Portslade.

Cross-examination continued: In 1866 we came before Parliament for power to take part of the land coloured buff on the plan. A great portion of that land has since been washed away by the sea. The referees reported that the site was good for our purpose, but that we had taken no power to have a road from it to the high road. By our present bill we take power to go under Shoreham Harbour with a main. If we erected our works on the part of the 1866 land which remains, there would be no necessity for that; but there are other difficulties in the way. We take power to erect warehouses on the towing-path of the harbour, where we can unload our vessels. There is no carriage-way along there now; we seek by our bill compulsory power to make it a carriage-way. There is a right of way to the Ingram estate on the sea side of the land, at high-water mark. The Harbour Commissioners are in favour of this bill, though they present a petition, as they did in 1866, for certain clauses. Mr. Upperton is the clerk to the Harbour Commissioners, and their solicitor. I do not know whether he was at any time solicitor to the Ingram family. He was solicitor to Mr. Fuller, by whom the property was left to Mr. Ingram. I believe that compulsory powers for gas companies are very common. We take power to erect groynes in front of the land we shall acquire. The effect of those groynes would be to cause the beach to the east of them to be washed away, but that action would not extend far. The distance from our site to the Ingram property is 450 feet, and I believe the effect of our groyning would not be to wash away the beach there. Groynes below high-water mark cannot be erected without the consent of the Crown. I do not think the site offered by the petitioners is so good as the one we have chosen. The pipe under Shoreham Harbour is an alternative proposition to the pipe along the towing-path.

Re-examined by Mr. MICHAEL: Compulsory powers were given to the Preston, Gomersal, South Metropolitan, and Bath Gas Companies, in 1865; to the Belfast, Grange and Cartmel District, Newark, and Ryde Gas Companies, in 1866; and to the Gaslight and Coke Company, the Lynvi Valley, &c., Companies, in 1868. If we do any injury by the erection of groynes we shall have to pay for it. The present towing-path in the harbour is quite wide enough for a carriage-way. We merely seek, in addition to that, an easement for our pipes.

John Birch Paddon, Esq., examined by Mr. JOHNSON.

I am a civil engineer, and have been the general manager of the Brighton and Hove Gas Company for the last ten years. I have had much experience in the construction and management of gas-works, and am well acquainted with all matters connected with the supply of Brighton. This company was established in 1825, and under their Act of 1866 the Gas-Works Clauses Act was incorporated, and certain obligations were put upon them with regard to the quality and illuminating power of their gas. Every protection was by that Act given to the public. The maximum price of gas is 3s. 6d. in Brighton and 4s. in Portslade; the illuminating power is 14 candles. There is provision in the Act for testing the gas, and unusual powers are given to the corporation in reference to the auditing of the accounts. I know of no Act in which more rigid regulations have been provided. There has been a very large increase in the area of supply and in the number of consumers during my time. In 1859 the consumption of gas was something like 71 million cubic feet per annum; in 1869 it was 173 millions. The actual production now is about 200 million cubic feet per annum, and I see no reason to doubt that the consumption will go on increasing in the same ratio, there being some large districts laid out for building which we shall have to supply. The site of our present works is a little over three and a half acres. It would be possible, by pulling down these works and erecting new ones, to obtain greater capacity on that site, but it would be a large and unwise expenditure of capital. We suffer great inconvenience and loss from not having room to store our coke. The demand for coke is very unequal, and we are sometimes compelled to make forced sales at low rates. We have not storeage for a week's production of ashes, and we have to rent a place at two miles distance to cart them to. The coal storeage room is insufficient, and we have to pile up the coal in stacks 22 or 23 feet high. Our works are a mile and a half from the vessels by which our coals are brought. We receive over 20,000 tons a year, which are not improved by being carted from the wharves. We receive fire-bricks, pipes, &c., and occasionally ship coke from the basin, all of which have to be carted. By the Act of 1866 we were prohibited from manufacturing residuals at the works at Hove; we therefore sell them to a contractor, who removes them to a distance of four or five miles by night, which is a costly proceeding. Strange to say, the complaints of our works from the inhabitants have been more numerous since 1866, when we ceased to manufacture residuals.

By Sir JOHN DUCKWORTH: In 1865 we were paying 10 per cent. The effect of the reduction in price to 3s. 6d. was to reduce the dividend earned to 3¼ per cent., but we did, in consequence of having a reserve-fund, actually pay 5 per cent. Since that time, partly through the decrease in the cost of coals and the increase in our business, we have been able to pay 7 per cent. A portion of our capital is limited to that rate, the remainder is entitled to 10 per cent.

By Mr. JOHNSON: The proposed new site is strictly within the definition of the referees report of 1866, and it is actually valueless for any other purpose. It is the best that we could select, having reference to our own interests and that of the public, and was chosen because it is the widest and most level, and is also higher than any other portion of that beach land, and therefore more easily and inexpensively defended from the sea, while it is entirely removed from possible building sites. It is about 700 feet from the nearest inhabited house. We propose to erect a wharf immediately in front of the works, but that will not interfere in the slightest degree with the traffic of the harbour, and I believe the Harbour Commissioners are of that opinion. The present wharves are utterly inadequate in the winter time for the ships there seeking to discharge their cargo. We now pay tonnage of a fraction over 10d. per ton, and should continue to do so. It is essential to get a parliamentary title to the land upon which we propose to erect our works, and not to buy it by private agreement. I have known the road referred to in the petition for 15 years, and have always regarded it as a public road. So far as I can make out, the petitioners have never expended a farthing in the construction or maintenance of that road. There is no fencing upon it; it is something like 20 feet wide on the top, and our pipes could be laid under without the slightest detriment to it. There would be no difficulty in laying a pipe under the harbour. It could be done when the commissioners drain the harbour, as they do sometimes, without the slightest interference with the traffic. As the engineer of the company I desire to have both modes of carrying the mains. We supply districts, seven or eight miles to the west, which are growing in importance; and it may be some day very necessary that we should be able to take our main across the harbour in the way proposed. There has been a considerable encroachment on the sea-shore. Since 1843, on some parts of the beach, the sea has advanced 400 feet. In 1866 the high-water mark was specially surveyed and mapped, and in November last it was found that it had advanced nearly 100 feet in the interval. The ratio of increase is not invariably the same. The Harbour Commissioners have erected groynes which have effectually resisted the inroads of the sea. I believe the property of the petitioners will be unaffected by our works. Whether we go there or not their property is bound to disappear in time, unless they erect groynes for its protection.

Cross-examined by Mr. RICHARDS: The tendency of the erection of groynes is to make the beach on the east side of them disappear. The cost of each groyne is about £200. We shall have no gasholders at our new works; our present works will be used entirely for storeage. We could not get sufficient land for our purpose upon the 1866 site now, and there would be a difficulty there in obtaining our coals. We should have no difficulty in getting through next winter, with a little additional expense, at our present works.

Mr. JOHNSON: There is nothing in your petition which raises the question whether we want further room.

Mr. RICHARDS: My object is to show that there is no necessity for the company to obtain an Act this year, and that they might come again to Parliament next year, and take the land we offer them. I distinctly say that we offer them a piece of land with an indefeasible title, and which is better adapted for their purpose, and that there will be no inconvenience to the public if the powers now sought are refused, as they have, according to the witness's last statement, sufficient room for next winter.

Cross-examination continued: There are wharves on the south side of the Wish Basin, where ships do unload. We get all our coals there now, and it would not be very far to carry them thence to the new site. We are to lay our main under the harbour, three feet below the surface of the bottom. As the harbour is dredged, we might have to sink them three feet lower still, but we should go considerably deeper than that at once, beyond any chance of disturbance.

Re-examined by Mr. JOHNSON: The alternative site offered to us by the petitioners is a part of the land which the Aldrington Company are under contract to purchase. I see no objection to limiting our power to groyne to the extent of our own property.

Mr. *Samuel Saunders*, examined by Mr. JOHNSON.

I am the harbour-master at Shoreham. I know the site of the proposed new gas-works. I consider it well adapted for the purpose. Twenty-five years ago we commenced erecting groynes to the east of the harbour, and it has been necessary, in order to preserve the harbour, to carry on that work ever since. Each groyne costs about £200, and we have erected 39. It is indispensable, if the promoters get the land they seek to require, that they should have power to groyne for their own protection. The immediate effect of groyning that land will be that the sea will encroach beyond them. I think the site well adapted for the erection of a wharf, which will not in the least interfere with the navigation of the harbour. The commissioners are in favour of this bill. By our Act we have power to erect wharves anywhere, or to authorize other persons to do so, and to do any other work necessary for improving the navigation of the harbour and the use thereof by the persons trading thereto. We have power to direct where vessels shall be berthed. The construction of another wharf would be a great advantage to us, as there is frequently a want of accommodation in the winter time. It would occasion no loss to the commissioners if the company erected one, as they would still receive the some tonnage dues. It would be no detriment to the harbour to lay pipes under the bed. We have let the water out eight times since 1855 for the purpose of repairing the lock. It is necessary to do so at intervals, and there would be no difficulty in laying the pipes at such times when the water was out at spring tide. There would be not the slightest difficulty or inconvenience in laying pipes along the towing-path.

Cross-examined by Mr. RICHARDS: The erection of the proposed wharf would not interfere with the towing-path. There is very little horse towing; it is nearly all done by steam. We made the towing-path, and I suppose are bound to keep it open. We petitioned against the gas company's bill in 1866, as we have done now, for the purpose of getting clauses inserted, but there is no hostility in our opposition.

Re-examined by Mr. JOHNSON: There have been various claims made to all this land and parts of the foreshore. I think the objection we had to the bill of 1866 was that the gas company were going to take a part of our south wharf. All the roads, as well as the towing-path for the whole length, and between the Wish Basin and the Wish Pond, were made by the commissioners, and have since been maintained by them. There was some arrangement made between them and the Ingram family. All persons desirous to use the roads have done so without any objection or interruption whatever, but since posts were put up carts could not go down the towing-path. There is a carriage-road to the south-east of the Wish Basin. It was made in 1855, and has been used by all persons. When we drain the harbour we shall have the water out two months, and in spring tides it empties to nothing.

By Sir JOHN DUCKWORTH: At ordinary spring tides there is 21 feet 6 inches over the seal.

John Aird, Esq., examined by Mr. MICHAEL.

I have had a great deal to do with the erection and maintenance of gas-works, and with the crossing of tidal harbours with mains. I know what is proposed to be done here, and think there will be no difficulty in laying and maintaining a pipe in the way intended. I should have no hesitation in contracting for the work; it would involve no great engineering questions.

Cross-examined by Mr. RICHARDS: I have laid gas-pipes in rivers and docks. It is more expensive than laying them in the ground, and would not be done if it could be avoided. In Amsterdam we cross more than one hundred presenting greater difficulties than there are in this case.

Thornton Andrews, Esq., examined by Mr. MICHAEL.

I have been engineer to the Swansea Gas Company for 15 years. At Swansea we have a cut and also a navigable river, and we have crossed both with pipes to supply gas. There is one at the half-tidal basin, one at the North Docks, and one at the river Towey. At the Towey there is always a very heavy flow of water, which at the most favourable time is from 3 to 5 feet in the centre of the channel, and there are 18 inches of water at the side. The gas company laid a main across in 1860, and there was then 5 feet of water standing in the mid-channel of the river. It was passed over by means of short coffer-dams about 30 feet at a time, and in 40 days the work was satisfactorily completed. From that time to the present the main has given no trouble. The circumstances at Shoreham are more favourable than they were at Swansea. If the harbour were drained at the time, the bed of the river would be comparatively dry, whereas at Swansea there were constantly from 3 to 5 feet of water in the middle. We never had any difficulty at Swansea through the accumulation of naphthaline in the main. The depth from the coping at the North Dock to the

seal is about 29 feet, and to the bottom of the pipe or syphon 38 feet. At the river Towey it is from 36 to 38 feet dip from the coping to the bottom of the pipe. Under no circumstances, whether the water was let out or not, have we found any difficulty, nor have we had any damages to repair. There has been no extraordinary expense in laying and maintaining the pipe.

Cross-examined by Mr. RICHARDS: In this case I should probably carry the pipes both ways—*i. e.*, across the river and along the towing-path.

F. J. Evans, Esq., examined by Mr. MICHAEL.

I am the engineer of the Chartered Gas Company, and was appointed by the Board of Trade one of the referees under the City of London Gas Act, 1868, but I have resigned the appointment. I have had experience in every department connected with the erection of gas-works. I am now engaged in the erection of the large new works at Beckton, of which I am the engineer, which works are designed for the carbonizing of 1000 tons of coal daily. I know the works of the Brighton and Hove Company, and also the site of their proposed new works, which I believe is in every way well adapted for the purpose. Gas-works can be beneficially erected there in the interests of the public. We took the whole of our land at Beckton under compulsory powers.

Cross-examined by Mr. RICHARDS: No landowner opposed us at Beckton. There is no question that going along the road with pipes would be better than going under a harbour like Shoreham. I think five acres of land would last the company for many years.

Thomas G. Barlow, Esq., examined by Mr. MICHAEL.

I have had large experience in the erection and maintenance of gas-works during many years. I gave evidence for this company when their bill was before Parliament in 1866. I believe it would be for the public advantage that they should have increased facilities for manufacturing gas; they could do so at considerably less expense than at Hove.

Cross-examined by Mr. RICHARDS: I gave evidence in 1866 in favour of the acquisition of the land at Aldrington, as being good for the purpose of erecting gas-works and coal-stores thereon.

Re-examined by Mr. MICHAEL: That land possesses no additional advantage over the site now asked for, indeed they could not land their coal so conveniently; it would all have to be carted or wheeled into the works.

This was the case for the promoters.

Mr. RICHARDS addressed the committee on behalf of the petitioners, and said he would, in the first place, set his clients right in reference to their non-appearance to oppose the bill in the House of Lords.

The CHAIRMAN said it would not be necessary, as that circumstance would have no effect upon the minds of the committee.

Mr. RICHARDS said the promoters of this bill came before Parliament in 1866, and they then proposed to take a piece of land which the Aldrington Company also proposed to acquire. The committee to whom both bills were referred passed the bill of the latter company, and expressed a strong opinion that the works at Hove should not be increased for residential reasons, and that any future land taken by the present company should be on the beach between Shoreham Harbour and the sea. He was quite ready to admit that the land now asked for met the recommendations of that committee; but, on the part of his clients, he distinctly offered to sell to them land to the extent of 5½ acres, which would be better suited for their purpose, at a fair market price, with a good title, and nearer to Brighton. Why did he propose to do this? He would explain to the committee how the plan of the promoters prejudicially affected his clients. After long-protracted and expensive litigation, Messrs. Ingram had established their right to the parts marked buff on the map, and to the green part where the posts were put up, which gave them what he would call the neck of the bottle; and it was not fair that the gas company should be allowed to go to the site they proposed, and to convert the towing-path into a carriage-way. They considered that one of the valuable features of their estate, to acquire which they had spent so much money, was that it commanded access to Colonel Lloyd's property beyond. He had been told that he was like the dog in the manger. It might be so, but he still contended that it was taking from his clients a very important part of the value of their estate, when, in order to accommodate the gas company, an advantage was given to Colonel Lloyd over them after the litigation which had taken place. There was no question that the entrance to the towing-path was their property, and they asked the committee not to allow that path to be converted into a carriage-way, which would certainly be detrimental to their interests. On the subject of the proposed groynes, he would not call any witnesses, because it was clearly established by the evidence of the promoters that if they were allowed to erect those groynes the action of the sea on the east would be injurious to his client's property. The company ought not, therefore, to be authorized to groyne their land without special provisions being inserted in the bill to protect them. It was a great hardship that, under cover of a *quasi* private bill, Parliament should interfere between Colonel Lloyd and Messrs. Ingram. He offered them suitable land for the purpose of the works of the company, which was free from that objection, and they could come next year for power to acquire it, and it was shown by their own evidence that no inconvenience to them or to the people of Brighton would be involved in the delay.

The room was then cleared, and on the readmission of the parties,

The CHAIRMAN said: We have decided that the preamble of the bill is proved.

WEDNESDAY, JUNE 22.

The clauses of the bill were taken into consideration this day.

On clause 5, which provided that the company should reserve to and in favour of Colonel Lloyd a right of way at all times for himself, servants, &c., across the land on which the proposed works are to be erected, along the southern boundary thereof, to his land on both sides thereof,

Mr. RICHARDS objected to the wording of the clause, as prejudicially affecting his clients. His learned friend, Mr. Michael, would probably say that the petitioners were not interested in this matter, but he (Mr. Richards) contended that by the clause, if it was allowed to stand in the bill, a sort of parliamentary title would be given to Colonel Lloyd with reference to the adjoining land. He proposed that Colonel Lloyd's name should be omitted, and the words "the persons owning for the time being any land on both sides and adjoining the said piece of land, and for their servants and tenants, in order that by the same right of way they may communicate with the adjoining land." If Colonel Lloyd had a right, these words would protect him; on the other hand, it secured the same right to any other person who established a right in the adjoining land.

Mr. MICHAEL denied that there was any assertion of Colonel Lloyd's title in the clause as it stood. According to the contention on the other side, Colonel Lloyd had no "land adjoining," therefore he could take nothing by these words. He was willing to meet the case by altering the proviso thus—"Provided that the company shall reserve to and in favour of George Kirwan Carr Lloyd, Esq., of Lancing, in the county of Sussex, his heirs and assigns, and other, the owner and owners for the time being," &c.

Mr. RICHARDS objected to the introduction of Colonel Lloyd's name at all, as being an inferential recognition of his title.

After some discussion, the proviso last suggested was adopted, the word "or" after "assigns" being substituted for "and."

On clause 13, which provides that the company shall take easements only in the towing path and road,

Mr. RICHARDS proposed the introduction of the following words, so as to pay for the easement thus acquired:—"The company paying or making compensation for such easements and rights of user as if they were land."

Mr. MICHAEL objected to the addition, and it was negatived by the committee.

Mr. RICHARDS proposed a new clause to follow. He objected to any unfair advantage being given to Colonel Lloyd, and if the committee thought that an increased right of way should be given over the land of his clients, to get access to the gas-works, it ought not to be used as a mode of access to Colonel Lloyd's land. He therefore asked the committee to insert a clause to the effect that if at any time the company construct any road under the powers contained in this Act, the same shall be used only for the purposes of their gas-works; and that they should be required to put up gates and a notice-board to prevent other persons using such road; and that, in case of their neglect or default in so doing, they should be subject to a penalty.

Mr. MICHAEL strongly objected to the introduction of such a provision, which he said was sought for only to satisfy a grudge between the parties contending for the land. He was willing to accept a provision to this effect: "If at any time the company shall construct any road under the powers hereinbefore contained, the same shall be used only for the purposes of this Act."

Mr. RICHARDS ultimately acceded to this proposal, and words were introduced into the 13 clauses to give effect thereto.

On clause 17, giving the company power to construct groynes,

Mr. RICHARDS desired to add a proviso, that if the land or property of the devisees in trust of the late Hugh Ingram should be damaged by reason of the said groynes, the company should make such compensation as might be agreed upon, or as settled by arbitration under the Railway Clauses Act.

After some discussion, the committee rejected the proposition, and accepted the clause in its original form.

The remaining clauses were then agreed to.

Miscellaneous News.

GREAT CENTRAL GAS CONSUMERS COMPANY.

An Extraordinary General Meeting of the Shareholders of this Company was held at the London Tavern, on Monday, June 20, "to consider and, if thought proper, to assent to the scheme for the amalgamation of that company with the Gaslight and Coke Company, as sanctioned by the Board of Trade, and to confirm the retiring allowance to Mr. R. M. Massey, sanctioned at the last general meeting, on his resignation of the office of secretary."

Mr. MASSEY having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen, you will remember that on the 8th of March we had a special meeting of the proprietors of this company, to consider the proposal then made by the Gaslight and Coke Company for an amalgamation with this company. The matter was discussed at great length by you, as its importance rendered it necessary, and you passed this resolution—"Resolved, that the directors be authorized to accept, and to take all the necessary measures to carry into effect an amalgamation with the united company, consisting of the Chartered and City Gas Companies, upon the terms of receiving a dividend of 7½ per cent. for the year 1869, and of 10 per cent. per annum thereafter, or at the maximum rate of dividend allowed by Parliament." In obedience to your indications, we prosecuted the matter, and gave your assent to the proposal, and as you learnt on the 29th of April, when you last met here, the scheme was sent to the Board of Trade for their approval. The Board of Trade, as directed by the Act of 1868, took the matter into consideration, and submitted it to the two public bodies who are interested in it—viz., the Corporation of the City of London and the Metropolitan Board of Works. They received from those two bodies such remarks as they thought proper to make upon it, and those remarks were sent to us. We made such replies as we thought desirable, and in the issue the scheme came out from the Board of Trade, in all essential particulars, exactly as you had agreed to it at your previous meetings. In accordance with the promise we then made, we called you together directly we received it from the board, and I have now the scheme before me, the chief provisions of which I will read, so that you may see that your interests have been efficiently cared for. When this scheme is approved by you it will receive the assent of the Queen in Council, and it will then have the binding effect of an Act of Parliament. (The chairman having read over the clauses of the scheme of amalgamation, proceeded:) I think, taking this scheme as a whole, we must all be sensible that it is a very becoming bargain for us to make; it is one which I think is good for ourselves, and I believe it is good for the other company. Regarding it in the light of a matrimonial alliance, it is satisfactory to know that we do not go to them dowerless. We take them a revenue of £100,000 a year in the City of London; we take them likewise the large balance of our revenue account to the end of the past year, amounting to £56,290, beside the half year's profits to the end of June, which have not yet been ascertained. Therefore, although they have to pay the balance of our defalcation account, it is a great satisfaction that in joining the larger company we go with assets in our hands which make the amalgamation a good bargain for them also. We all feel that, whenever a bond or contract is to be made, there should be entire mutuality. I believe in this case there is the most perfect mutuality between us, and I may just state to you that the directors visited the works of the Great Central Company last Saturday, and found them in first-rate condition, and I very much doubt, indeed, whether the united company will be able to manufacture gas in their splendid works at Beckton to much greater advantage than we have been doing at Bow Common; and I feel it reflects great credit upon our engineer, Mr. Harris, who is now present, that I am able to say that if it had not been desirable to carry out this bargain with the other company, in obedience to the dictum of Parliament, as well as in conformity with what, upon the whole, we deemed the most prudent course, we should have been able still to carry on our business as an independent company with great satisfaction to ourselves and continued benefit to the City of London. At the same time I must say, on behalf of my colleagues and myself, that this is our valedictory meeting, and that, although we part under such pleasing circumstances, that parting is tinged with some melancholy feelings. We have been in the habit for twenty years to meet you here, sometimes in sunshine, sometimes in storm, but in the main we have carried on our affairs with considerable success and advantage to all parties, and therefore it is not surprising that a somewhat melancholy feeling does come over us as we remember that we are here to-night for the last time as directors and shareholders in the Great Central Gas Consumers Company. However, I believe it is for the best; that we shall still be useful as united with a powerful confederacy manufacturing gas for the entire City of London, and some other parts of the metropolis, upon the best possible system, and in works of the best construction, and that in the main we shall not be disappointed in the results of the union. We shall continue to watch over your interests in joining the direction of the united company, and, from some little experience we have had of the gentlemen who form that board, we feel certain that we shall have the greatest satisfaction in working with them. Under these circumstances I have now to move—"That an amalgamation of the Great Central Gas Consumers Company with the Gaslight and Coke Company be approved, and that the scheme of amalgamation now submitted to this meeting be confirmed and adopted, and the seal of the company affixed thereto."

Alderman Sir THOMAS GABRIEL seconded the resolution, which was put, and carried unanimously.

The CHAIRMAN then moved—"That the directors be authorized to affix the seal of the company to the instrument necessary to secure to Mr. Robert Marsden Massey, on his resigning, after twenty years service, the office of

secretary, a retiring allowance of £500 a year during his lifetime, as sanctioned by the last extraordinary meeting of shareholders."

Mr. SKELTON seconded the motion, which was carried unanimously.

The CHAIRMAN, in answer to an inquiry, said the directors had not been unmindful of the services of Mr. Harris, the company's engineer. It was their province to fix the remuneration of that gentleman, and since the last meeting they had increased his salary from £500 to £750, such increase to take effect from the commencement of the year. Mr. Harris's valuable services would be transferred to the united company, and the directors thought they could not do better than mark their appreciation of his merits by the step they had thus taken. Mr. Harris had worked with them in the most friendly and cordial spirit, and the directors believed he was not only satisfied with the addition made to his remuneration, but also with the way in which it was done. They felt also that they were carrying out the wishes of the proprietors in thus recognizing his meritorious services.

On the motion of Mr. SKELTON, a vote of thanks was given to the chairman and directors.

The CHAIRMAN, in acknowledging the vote, said: We are much indebted to you, gentlemen, for this the last mark of your confidence. We shall, I trust, meet again, though not as a separate body, but as members of the larger body to which we now belong, and we shall represent your interests still, as well as the interests of the other shareholders, and you may depend upon it that the associations of the past will never be forgotten by us.

BOMBAY GAS COMPANY, LIMITED.

The Eighth Ordinary Meeting of the Shareholders of this Company was held at the City Terminus Hotel, Cannon Street, London, on Thursday, June 23—DANIEL THOMAS EVANS, Esq., in the chair.

The SECRETARY (Mr. W. Marshall) having read the advertisement convening the meeting, the seal of the company was ordered to be affixed to the register of shareholders.

The following report and statements of account were presented:—

Your directors, in meeting the shareholders of the company, have pleasure in presenting a statement of accounts to the 31st of December last, duly audited.

A perusal of the accounts will show that the company has made a satisfactory advance, and that almost every item in the statement of profit and loss is in favour of the company. There has been a considerable increase in the sale of gas, the cost of production has diminished, and the yield of gas per ton of coal carbonized has increased.

The new manager, Mr. Charles Gandon, entered on his duties in September last. A careful valuation of the company's stocks of every description has been made, and the board have in consequence written off from the reserve-fund the sum of £3404 18s. 3d. for deterioration of stock, fittings, furniture, &c.

The general revenue account (after payment of interim dividend and carrying to the reserve-fund £1009 4s.) shows a balance of £7488 16s. 10d. Out of this your directors recommend the meeting to declare a dividend for the half year at the rate of 6 per cent. per annum, free of income-tax, payable on the 1st of July next.

The directors retiring by rotation are Mr. D. T. Evans and Major W. F. Gordon, who, being eligible, offer themselves for re-election.

Dr. *General Balance-Sheet, December* 31, 1869. *Cr.*

To Capital authorized, viz.:—					By Construction			
(50,000 shares, at £5 each—£250,000.)					Interest paid to shareholders			
40,000 shares, £5 paid		£200,000	0	0	Amount due to the company			
10,000 „ £4 called up, and paid		40,000	0	0	Goods *in transitu*			
	£240,000	0	0		Stock in trade, viz.:—			
Amount owing by the company, viz.:—					Chandeliers, brackets, &c.			
Sundry creditors	£8,900	16	8		Brass and iron goods, tubing, &c.			
Interim dividend, Dec. 31, 1869 . £5,400 0 0					New works—materials			
Less paid on that date 2,370 0 4					Mains and services			
	3,029	19	8		Meters			
	11,930	16	4		Coal			
Reserve-fund for depreciation, &c.:—					Coke			
Depreciation-fund, June 30, 1869	£4,395	14	3		Tar			
Amount added this half year	1,009	4	0		Lime, tools, fire materials, &c.			
	£5,404	18	3		Cash at bankers and in hand	£5,442	0	0
Less written off stock, fittings, furniture, &c. .	3,404	18	3		Bills receivable	5,538	11	6
	2,000	0	0			10,980	11	6
Insurance-fund	101	5	2					
Balance from general revenue account	7,488	16	10					
	£261,520	18	4			£261,520	18	4

	£164,956	6	1					
	21,432	4	11					
	12,588	6	8					
	2,975	10	6					
	10,624	17	3					
	13,421	7	1					
	1,037	11	11					
	1,433	8	11					
	7,395	15	7					
	11,991	0	9					
	267	6	0					
	1,085	11	0					
	1,331	0	2					

Dr. *Profit and Loss Account, for the Half Year ending December* 31, 1869. *Cr.*

To Coal carbonized	£8,741	19	3		By Gas and meter rental	£20,838	1	3
Wages	832	8	7		Coke	2,589	4	1
Purifying	455	9	2		Tar	307	11	6
Maintenance of retorts	260	7	3		Incidental receipts	6	9	6
Trade and general charges	1,744	8	4		Fittings	146	8	5
Salaries and collectors commission	1,807	13	1					
Rents, rates, and taxes	851	10	0					
Exchange	150	2	3					
Passages	214	10	0					
Law expenses	48	10	4					
Directors and auditors remuneration	452	10	0					
Bad debts and allowances	65	14	9					
Amount carried to reserve-fund	1,009	4	0					
Net profit	7,253	7	9					
	£23,887	14	9			£23,887	14	9

Dr. *General Revenue Account, December* 31, 1869. *Cr.*

To Interim dividend for the half year ending June 30, payable Dec. 31, 1869	£5,400	0	0		By Balance unappropriated, June 30, 1869	£5,635	9	1
Balance available for dividend	7,488	16	10		Net profit for half year ending December 31, 1869	7,253	7	9
	£12,888	16	10			£12,888	16	10
					January 1, 1870.—Balance brought down	£7,488	16	10

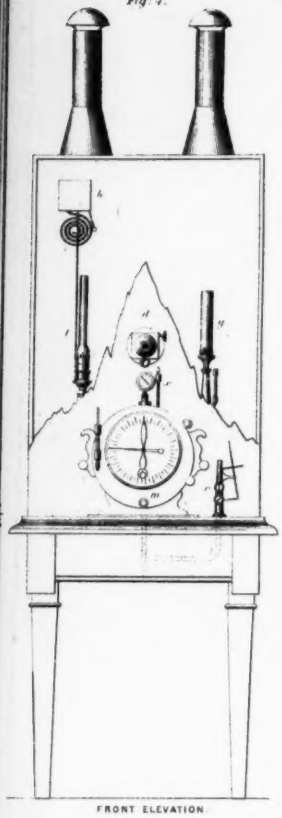
The CHAIRMAN: Gentlemen, the report now presented gives you a pretty clear notion of the condition of the company; and I think you will observe that it has made a very considerable advance in the period under review—viz., the six months ending in December last. I will, however, amplify the statements made in the report, as it has been my custom to do, and I hope to furnish some details which will be of interest to you. The report tells you that there has been a considerable increase in the sale of gas, that the cost of production has diminished, and the yield of gas per ton of coal carbonized has increased. It will be satisfactory to you to know that during the twelve months ending in December last, although we were burning cheaper coal, we were making more gas out of that coal than we had hitherto done. The cost of our purification was formerly very considerable. We purified by the use of lime, and the lime we have been in the habit of using, although it was the best we could get in the East, turned out unsatisfactory in its working. When Mr. Stephenson came into the direction, he was strongly convinced of the fact, and he induced us to change our system of purification, and to adopt the system of purifying with oxide of iron, which, I am happy to say, has turned out satisfactorily. I hold in my hand a report received from our manager as to the state of the works, and I shall have the pleasure to read it to you, as I am sure it will prove to be of great interest, and will give you much assurance for the future. That report, owing to the pressure of business upon our manager, in consequence of illuminations at the visit of the Duke of Edinburgh to Bombay, which necessitated great exertions on his part to meet the demands of the Government and Municipality, was not received by us at the time the report of the directors was prepared; but it is here now, and you will learn from it what he thinks with regard to the new system of purification. In reference to residual products, I may state that during the last year our coke yielded a fair price, but there has been some competition in Bombay, and we have not had so high a price as usual; but, to set against that, we have exercised great economy in the use of it under the retorts. This tells in two ways—we save in the quantity there burned, and have more to sell, so that the account for coke stands not in an unsatisfactory position. As to our coal, I had a letter put into my hand this morning from a large shareholder, a gentleman whom we all respect, in which he says: "There are two statements afloat in the market which it is very advisable to clear up forthwith. The first is that the company are under forward contracts for coal for a long time at high rates." Now, gentlemen, in reference to that, I can give the statement the most absolute denial, and when you have heard what I have to say upon the subject of coal, I think you will be perfectly satisfied upon the point. We get our coal cheaper from Australia just now than we can from England; and, as a matter of fact, I believe only three or four cargoes have gone out from this side under the contract for two years, of which one has expired. We have now 7000 tons of coal in Bombay, which is equal to twelve months supply. You remember I have had to stand here and tell you that coal has cost us £3 11s. per ton, but I am happy to say that latterly we have been putting it into our works at from £2 to £2 2s. per ton, and there is the main source of our profit. Our manager telegraphed to us that there was a cargo of Australian coal afloat in the ship *J. L. Hall*, which he thought he could purchase advantageously, and we telegraphed back to him to make the purchase. He did so, and was able to put 970 tons into the works, as fine coal as any obtained from Australia, at 35s. per ton. In this country freights and coals are now rising, but we have in hand, as I just told you, more than twelve months supply, and we have given instructions to our agent in Australia to provide another 2000 or 3000 tons, so as to enable us to put it into the retorts at the same price that we have been paying lately. Our new management at Bombay was installed last September; it had been at work only three months in the accounts before you, and we have every reason to be not merely satisfied, but well pleased with it. Our manager, as I before stated, has been through a period of some difficulty and anxiety, in consequence of the demands made on him to supply illuminations upon quite an unexampled scale of magnificence. I am happy to say that we had in hand among the stock of fittings a considerable number of devices—elephants, Stars of India, and other things likely to be acceptable to the natives. We utilized them, and we also borrowed a quantity of devices from Calcutta, where the Duke of Edinburgh had previously been visiting. The illuminations turned out, so far as we were concerned, a great success, and we gave every satisfaction. We have received, £1800 from the Government as their contribution towards the cost; that from Municipality is yet to come. I shall have presently to touch upon the leakage account, but I may just allude to it generally in passing. It stands, perhaps, high, but that is due very largely to the fact I am about to mention. We employed, under the advice of Mr. Hawksley our eminent engineer, Messrs. Piggott and Co., who have the reputation of being large gasholder makers, and we paid them for two very fine gasholders. The life of a gasholder, I am told, should be twelve years in the tropics, but I am sorry to say that, though the sides of our gasholders have remained perfect, there has been a most extraordinary destruction of the tops. This is said to be due to oxidation on the inside—some chemical action of the vapour of the gases which accumulates in the crowns, and which induces a scaling of the inner surface of the metal in a most unusual way. Mr. Proud, our late manager, whom I see here, can possibly explain it. However, there is the sad fact that the crowns of these magnificent gasholders have broken out in holes in every direction. We had a long and somewhat angry correspondence with the makers, but they said, "Your inspector passed the gasholders," and we had no remedy. The result is this: we have been obliged to provide new crowns, one of which is now upon its way. They will both of them be there before the monsoon closes, and by the end of September we hope to have the holders repaired. In the meantime we are doing the best we can to prevent leakage. The increase in the consumption of gas at Bombay is most satisfactory, as will appear by-and-by. With reference to the fittings, which have been so trying a matter with us, I am happy to say they are now going off at a great rate. We have sold nearly £3500 worth during the first three months of this year. I now proceed to comment on the accounts. If you will turn to the general balance-sheet, and look at the credit side, you will find that the "Construction" account at the 31st of December last stood at £164,956; on the 30th of June, 1869, it was £163,100, so that there has been an increase of £1856, for which I have to account. That increase is due chiefly to the settlement of a disputed claim with the con-

"PHOTOMETRY AS APPLIED TO THE ESTIMATION OF THE

BY T. N. KIRKHAM, C.E. AND W. [illegible]GG, A

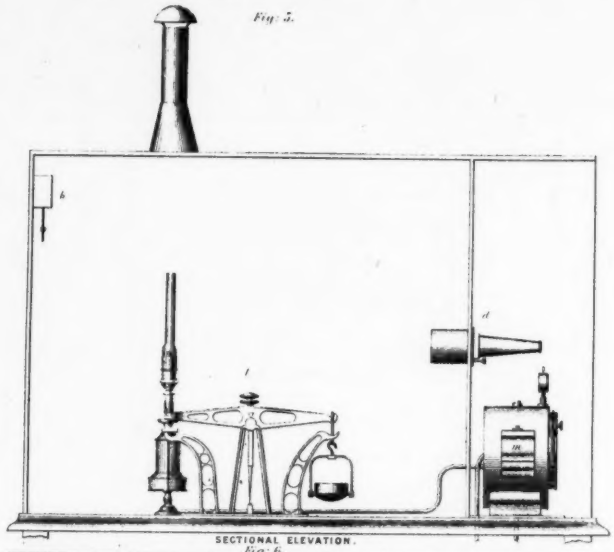
FRENCH PHOTOMETER.

Fig: 4.



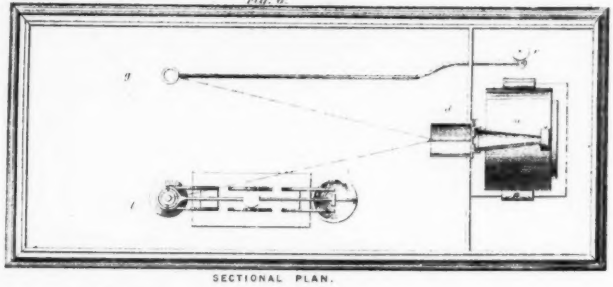
FRONT ELEVATION.

Fig: 5.

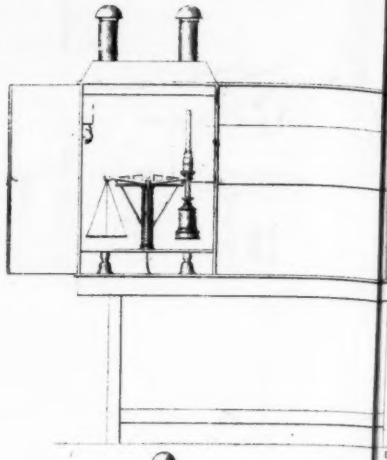


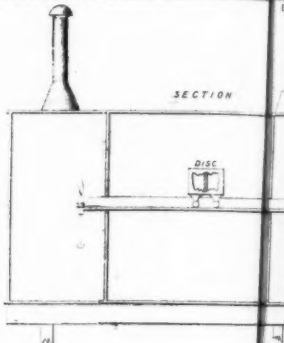
SECTIONAL ELEVATION.

Fig: 6.



SECTIONAL PLAN.





ELEVAT

ECTION ON

DIAGRAM Nº 1.

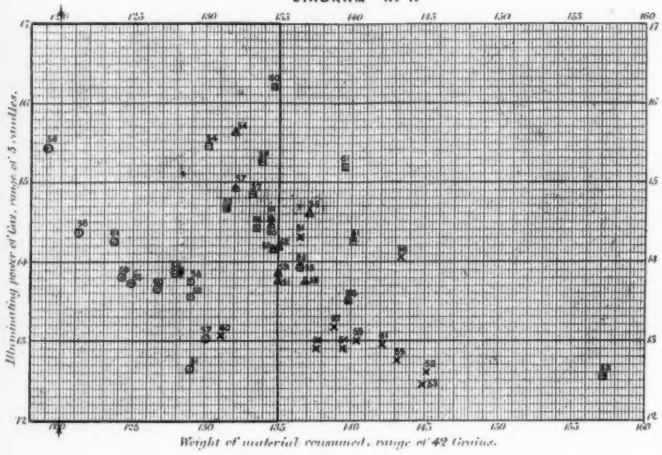


DIAGRAM Nº 5.

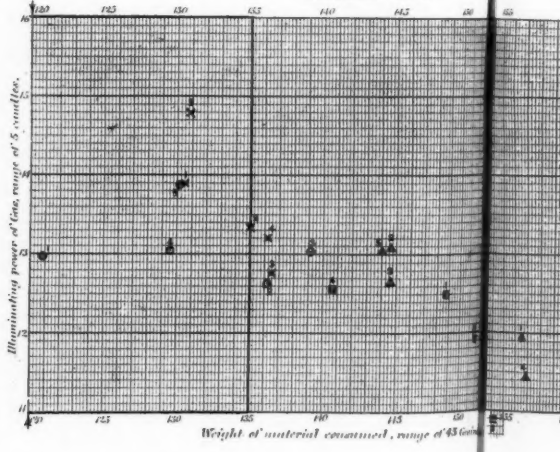


DIAGRAM Nº 4.

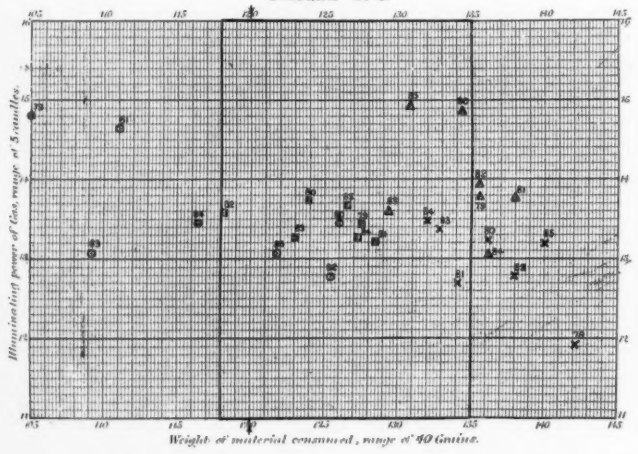
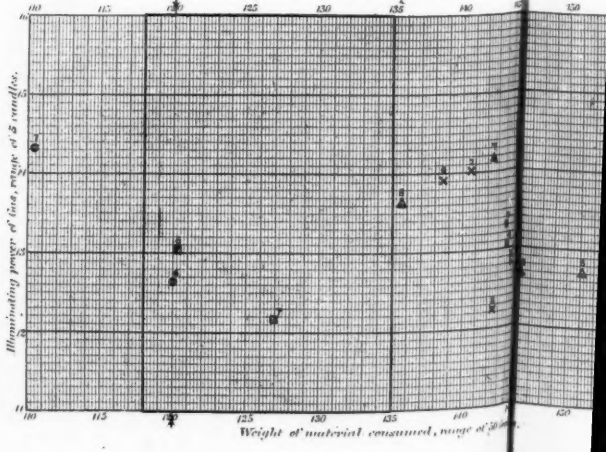


DIAGRAM Nº 6.



The 'black' lines on the Diagrams Nº 1 and Nº 4 to Nº 109 and Nº 109, enclose all those experiments which are considered by some of the most careful operators to be within proper limits, and which give the least error when corrected to the Parliamentary Standard.—

The [illegible] and [illegible] taken [illegible] "Cross" Ph[illegible] Photom[illegible] Scale, at w[illegible] made[illegible]

Diagrams Nº 1, 4, 5, 6, show "Readings of [illegible]ter

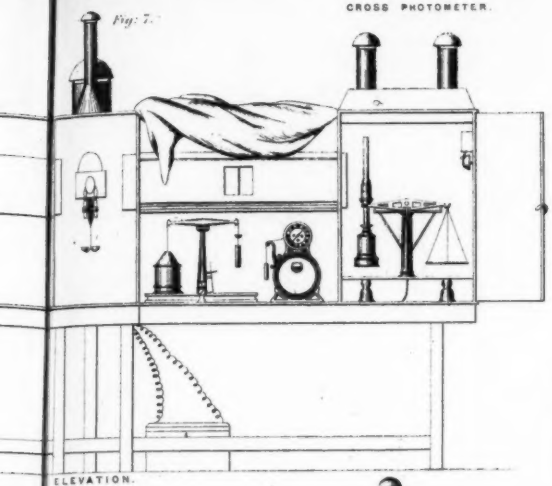
Photo-Lithographed by Whiteman & Bass, London

ATION OF THE VALUE OF COAL GASES"

AND W[illegible]GG, A.I.C.E.

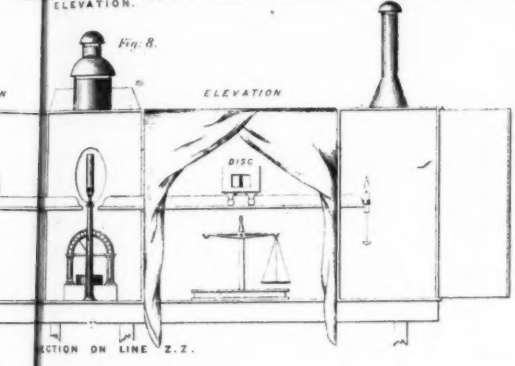
CROSS PHOTOMETER.

Fig: 7.



ELEVATION.

Fig: 8.



ECTION ON LINE Z.Z.

Fig: 9.

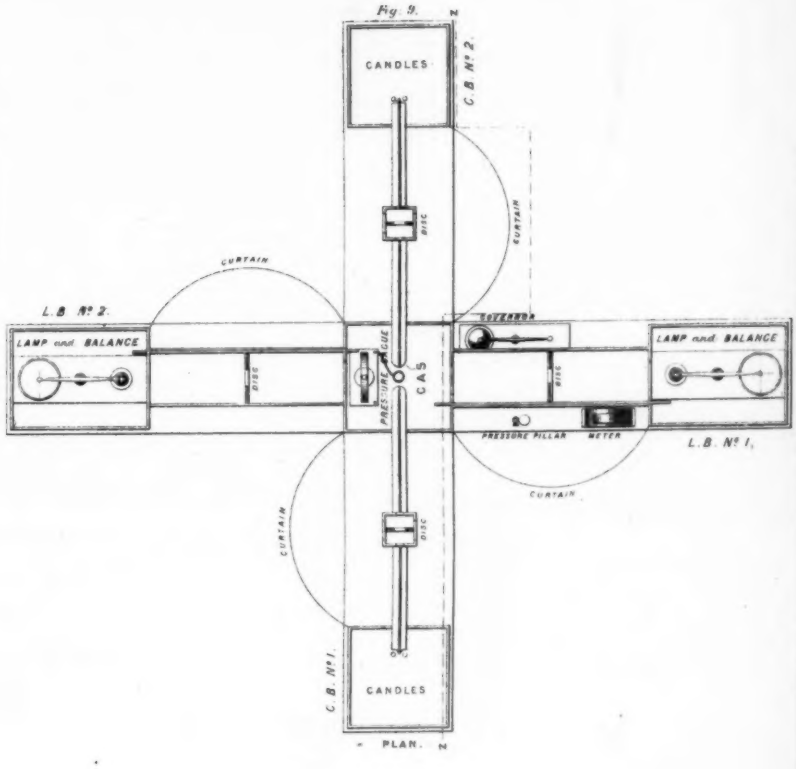


DIAGRAM Nº 10.

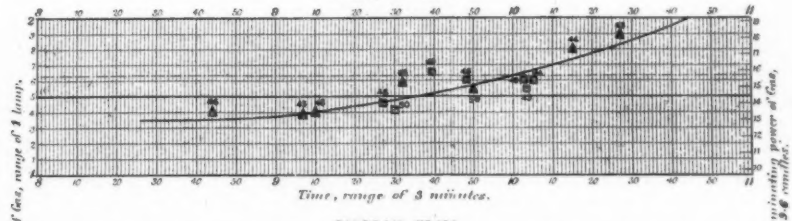
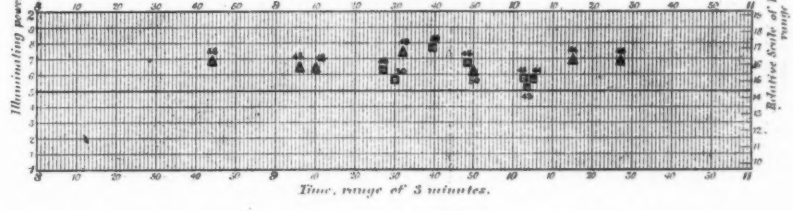
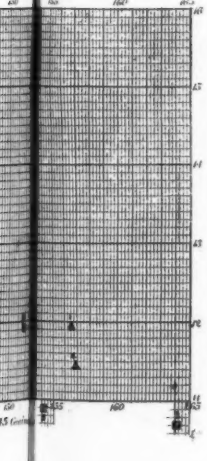

Illuminating power of Gas, range of 1 lamp.
Relative Scale of Illuminating power of Gas, range of 3-6 candles.
Time, range of 3 minutes.

DIAGRAM Nº 10½


Illuminating power of Gas, range of 1 lamp.
Relative Scale of Illuminating power of Gas, range of 3-6 candles.
Time, range of 3 minutes.



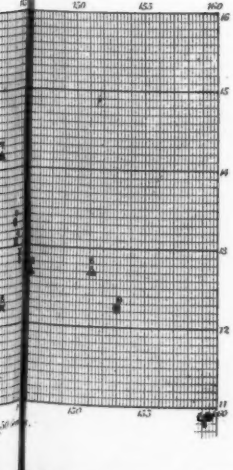
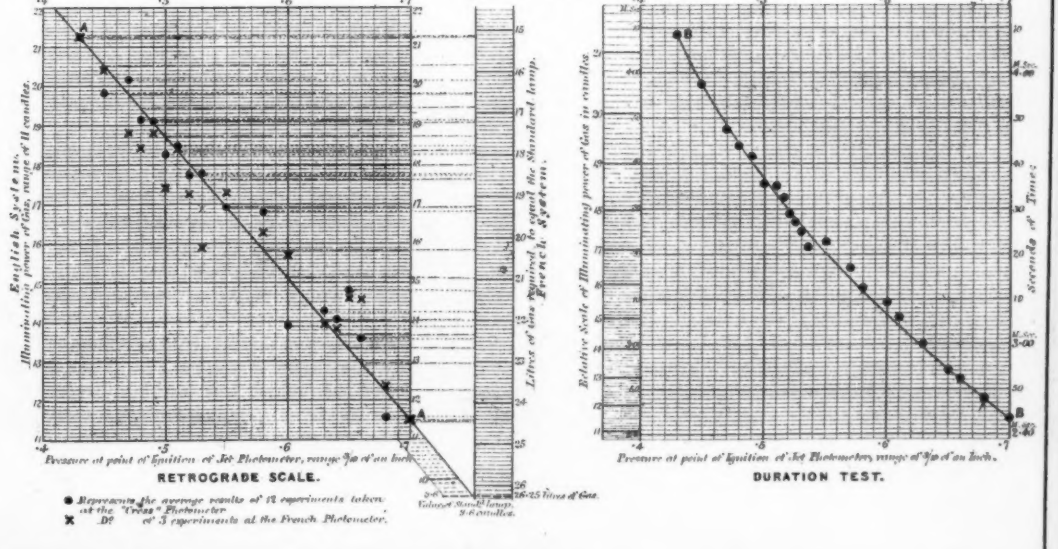


DIAGRAM Nº 38.


English System.
Illuminating power of Gas, range of 11 candles.
Pressure at point of Ignition of Jet Photometer, range 3/10 of an inch.
RETROGRADE SCALE.
Litres of Gas required to equal the Standard lamp.
French System.
Volume of Standard lamp. 9·6 candles.
26·25 Litres d'Gas.
Relative Scale of Illuminating power of Gas in candles
Seconds of Time.
Pressure at point of Ignition of Jet Photometer, range of 3/10 of an inch.
DURATION TEST.

● Represents the average results of 12 experiments taken at the "Cross" Photometer

× Dº of 3 experiments at the French Photometer.

●, ×, ■ and ▲ represent experiments at the "Cross" Photometer, indicating the Scale, at which each experiment was

tractors for laying the mains, which had been pending from the time we first canalized Bombay, and which we have now settled by the payment of £1100. The remaining portion is due to new pipes and services. The next item is "Amount due to the company," £12,588. It is £694 less than at the close of the last half year. The amount of outstanding debts continues to be about three months income, as before, and I think you will not consider it very large. In 1866 they stood at four and a half months income. "Goods *in transitu*" on the 31st of December were £2975. That was chiefly coal, and is about the same amount as before. Then comes "Stock in trade," respecting which we have had a very careful valuation made. Of course there must have been a considerable deterioration in fittings in a climate like Bombay, and it was an instruction to our new manager to go through them item by item, and to put a fair marketable value upon everything. This has been done, and we have written off for depreciation £3404, which with the sales of gas-fittings, amounting to £1800, shows a reduction of £5204 in the value of our stock. The items of coal, coke, and tar speak for themselves. If you turn to the debtor side of the general balance-sheet, you will see the amount owing by the company (the capital stands the same—viz., £240,000) was £8900, which is about the same as it was last half year, because the £5400 included the dividend (£6666) payable on the 1st of July. To "Reserve-fund for depreciation" we have set aside, during the half year, £1009, which, with the £650 so appropriated last time, makes a total of £1659 in the year, or just 1 per cent. upon the construction account. The next item is the "Insurance-fund," which has been increased from £2 5s. 9d. to £101 5s. 2d. I told you last time that we intended to be in part our own insurers, and this amount represents the premiums we should have paid since we adopted that course, and I am happy to say that the risks have all run off. The balance from general revenue account is £7488 16s. 10d., which is the sum available for dividend. The next division of account is "Profit and loss." The coal carbonized in the six months was 3583 tons, costing £8742. The cost of coal per ton in 1867 was £3 1s. 7d., in 1868 it was £2 14s., and in the year ending the 31st of December last it was £2 7s. 4d., showing a considerable reduction in favour of the company. The yield of gas per ton averaged for the last six months 9081 cubic feet, as contrasted with 8852 cubic feet for the previous six months—increase, 229 cubic feet per ton. The gas sold and paid for per ton during the last six months was 7934 cubic feet, as against 7667 in the previous six months, showing an increase of 267 cubic feet per ton. The total quantity of gas made in the six months was 32,500,000 cubic feet; during the preceding six months it was 27,900,000 cubic feet, being an increase of 4,600,000 cubic feet. The gas sold last half year was 28,426,200 cubic feet, as against 24,220,400 in the previous half year, being an increase of 4,205,800 cubic feet. Our leakage was nearly 13 per cent., and I have given the reason for that. Wages were £882, which shows a balance in favour of the company on that item of £96. In our purification, £455, there is a balance of £107 in favour of the company in consequence of the new system adopted of purifying by oxide instead of by lime. In the item of "Maintenance of retorts" there is a balance of £136 in favour of the company. Trade and general charges are nearly the same as before. In salaries and collectors commission there is an increase of £184. This is due to the increase in the gas-rental upon which commission is paid; we have received a much larger amount, and as we pay by commission, this additional £184 is accounted for. "Rent, rates, and taxes" show an increase, due to the income-tax paid in England and India, of £390. There is in other respects a reduction of £100. "Passages of servants of the company" are about the same. In "Exchange," I am sorry to say, there has been a loss of £150; the fact being that exchanges have been uniformly adverse to us. Throughout the year we have never had a single transaction in our favour, but in the previous half year there was a profit of £92, which must be set off against this £150. "Directors and auditors remuneration" are the same on the year. "Bad debts and allowances" are £59 less. I think, when you see that they only amount to £65 upon our very large rental for the half year, you will consider it a circumstance upon which we may fairly congratulate ourselves. Turning to the credit side of the profit and loss account, you will find that the "Gas and meter rental" for the six months amounted to £20,838. For the previous six months the rental was £17,884, so that there has been an increase of £2954. The "Coke" for the six months under review yielded £2589; for the previous half year it yielded £1878, so that here again we have an increase of £711. Of course, if the price of coals is low, the price of coke is necessarily low, so that I think we have done well by that item. It has been the policy of our manager to sell off as much coke as he possibly could, so as to clear out the store before the rains set in. On "Tar" there is a decrease of £460, which is due to competition, and a consequent reduction of price. "Incidental receipts" are £92 less, which is due to accidental causes. "Fittings" for the six months show a profit of £146, which contrasts favourably with the previous half year, when there was a loss of £587. I have now done with the review of those points which I thought it necessary to notice in the accounts. The result, as you see, is a balance of £7488, out of which your directors recommend you to declare a dividend at the rate of 6 per cent. for the year. (The chairman having read a report from Mr. Gandon as to the state of the works, which was regarded by the meeting as highly satisfactory, continued:) Gentlemen, perhaps it may interest you to know what progress the company has been making this half year. During the first four months of 1870 we manufactured 22 million cubic feet of gas, being an increase of 3 million over the corresponding period of last year. We sold during the first four months of 1870, 19 million cubic feet, as against 16 millions in the corresponding period of 1869, being an increase of 3 million cubic feet. The coal carbonized in the first four months of 1869 was 2135 tons, in the same period of this year it was 2355 tons, while the quantity of gas produced per ton in 1870 was 9300 cubic feet, as against 8979 in 1869. Gentlemen, I have nothing further to say, except to express my entire confidence in the future of the company, and I trust that what I have said, and the figures which I have given you from the books of the company, will inspire similar confidence in all the shareholders. I have now to move—"That the report and statements of account which have been circulated among the shareholders be received and adopted, and that a dividend at the rate of 6 per cent. per annum, free of income-tax, for the half year ending the 31st of December last, be now declared, payable to the shareholders on the London register on the 1st of July next, and to those on the Bombay register three days after the arrival of the outward mail on the 24th inst."

Mr. H. P. STEPHENSON: I shall be happy to second the motion, and there are one or two points upon which I should like to add a word. With reference to "forward contracts" for coals, I was not aware that there was any report to the effect that we had entered into such contracts. I may state it as a fact that in April, 1869 (as the chairman stated on a former occasion), the board made a contract for two years with Messrs. Stephenson Clarke, and Co. for Pelaw Main coals, at 6s. 6d. per ton at the spout, or 6s. 9d. per ton in the Tyne Docks. That contract was made quite with my concurrence, and I think with the entire concurrence of all the other directors. My only regret was that we did not make the contract for five years instead of two, for I believe coals are going up, and the probability is that we shall not be able to renew that contract on such favourable terms. As regards Australia, we have no time contract for coal there, but we are paying for them 8s. per ton, which is the price charged by all the Australian coal companies. With reference to the gasholders, Messrs. Piggott's name having been mentioned, I think it right, having some knowledge of that firm, and having as an engineer seen work of theirs for some years past, to say that I do not consider the failure in the crowns of those gasholders arose from any default on their part. I believe myself, so far as I have been able to investigate so intricate a question, that the failure arose from improper storeage on board ship, and from improper exposure of the plates when they arrived at Bombay. Probably some sea water had got over them, and the damage was caused in that way. You will probably say, but if that was the case with the crown, why did not the same thing occur with the sheets of the sides of the holders? I reply that those sheets are constantly moving up and down, and being daily lubricated by the oil on the top of the water in the tanks, and, therefore, they are not so much exposed to oxidation. The chairman has pointed out to you that there has been a considerable improvement in our purification. I felt when I joined the board that the proper system of purification for us to adopt was that by oxide of iron. For many years the Singapore Gas Company have been employing it, and our purification there costs only ¼d. per 1000 cubic feet, whereas at Bombay it has cost 5d. I think, however, that the figures of the present balance-sheet hardly show the improvement derived from the new system of purification, and I shall be exceedingly disappointed if, in the next half year, the cost of purification is not very much lower. I believe our manager only began to use oxide entirely in the month of December. So that you really have in the present balance-sheet the result of five months of the old system, and only one of the new; therefore I speak somewhat confidently when I say that the next half year will show a considerable improvement in this matter. As regards the reserve-fund, we have, as you know, written off £3404 for depreciation of fittings; and the reason we have done that is that our manager represented to us that there was a depreciation to that amount in that part of our stock. It was, of course, no use keeping up the reserve-fund nominally on the one hand, while there was actual depreciation on the other; and therefore we, acting on the report of our manager, adopted this step. I have great pleasure in seconding the adoption of the report. I believe there is a bright future for this company. I cannot look forward and prophecy what events may take place, but I think, with the improvement in the supply of gas, we shall ultimately have to lower the price, so as to induce an extended consumption. I have seen for many years the impolicy of keeping up a high price of gas; but, of course, reductions must be made gradually and judiciously, and when the proper time arrives for making such reduction, I have no doubt it will stimulate consumption, and seeing that, without any enlargement of our plant, we can send out double the quantity of gas we are now supplying, I think we may look forward with satisfaction to the future prospects of the company.

Mr. THORPE said he thought the shareholders might congratulate themselves that the company had no debenture debt and no preference shares, that there was £10,000 of capital yet in hand, and that the capacity of the works was such that they could meet a very much larger demand for gas than at present existed without additional outlay. But while things were thus encouraging, a few words of caution might not be unacceptable. The first point which occurred to him was the necessity for economy in the administration, which, with all respect to the directors, he did not think had been sufficiently observed in the past. With reference to the defect in the gasholders, it appeared to him that the directors should have kept a portion of the cash in hand, so as to indemnify themselves against such a contingency until the perfect soundness of the work had been ascertained. As to fittings, he thought that, having the advantage of the Suez Canal and telegraphic communication with India, it would suffice to keep two months supply in hand, and therefore his suggestion to the directors would be, "Work the wire, and save the stock." It must be borne in mind that if the profits of the company were to be increased, the consumption of gas must be extended, and if the directors would enlarge their trade and keep out competition, they must lower the price of gas. He was in hope that before another two years were over the company would be able to pay 8 or 10 per cent.

Mr. PROUD (the late manager of the company's works) said he cordially endorsed the remarks made with respect to Messrs. Piggott. The failure of the crowns of the gasholders appeared to him to be quite an exceptional matter, and he had never himself blamed that firm as being the cause of it; and he might state that this was the only misfortune the company had had to contend with from the commencement of the construction of the works to the present time. They were in possession of a thoroughly good plant, the mains from the works were 24 inches in diameter, and there was nothing in the streets less than 3 inches. He was pleased that the leakage continued low, and considering the state of the gasholders this seemed to be very satisfactory.

The CHAIRMAN said: As soon as the directors found that the evil was irretrievable, they entered into a contract with Messrs. Hanna Donald and Wilson for new crowns. It was, after all, a small matter as to the cost, because the new crowns only cost £320 on this side.

Mr. PROUD said he congratulated the company on the change which had been made in the system of purifying the gas. The system of purifying by lime, which was formerly employed, was carried out under the instructions of the company's engineer-in-chief, and, of course, the manager would have incurred grave responsibility if he had set up his judgment in opposition thereto. Lime in India was most expensive, and of very little use in purification. The cost was between 1d. and 2d. per 1000 cubic feet of gas, whereas the oxide purification cost less than ½d. But, then, it should be stated that formerly one-half of the foreman's salary was added to the cost of purification, and one-half of the passage-money, as well as other matters; whereas, properly speaking, the charge for materials and workmanship only should have been included. With regard to the coal contracts he was satisfied, and he wished to state it most distinctly that the board of directors, in providing a supply of coals for Bombay, had done the best they could under the circumstances with which they had to contend; but, most unfortunately, during his management nearly half the coal arrived at Bombay during the rainy season, which caused great deterioration in its gas-producing qualities, and had told most seriously against the working of the concern up to last year. He was sure that thousands of tons of coal had been received in Bombay which never produced 7000 feet of gas, because it was not in it; and when, immediately on his return to England in October last, he waited upon the board, he most urgently called their attention to the importance of regulating the time for the arrival of coal in India. With reference to the public supply of gas in Bombay, he hoped soon to hear that the contract with the Municipality had been settled, for it had been a matter of great anxiety to him in the past. The price the company were now obtaining—viz., 7 rupees per 1000 cubic feet—was a price which compensated to some extent for the loss sustained by the company in the destruction of retorts in consequence of the intermittent system of public lighting. He was exceedingly pleased to find that the board had written off a portion of the reserve-fund to cover the depreciation in the fittings, and he hoped they would continue to adopt the same course each half year. The destruction of metal work in a climate like that of Bombay was always very large, and it would be wise to reduce the stock to as low a figure as possible.

Mr. STOKES said he was pleased to see that the company was rapidly getting into a thoroughly sound state. This time last year everything looked very different, but they now appeared to have turned the corner, and to be going on most satisfactorily. He was glad also that the suggestion he made to the board to authorize the manager to purchase coal in Bombay whenever an opportunity offered had been acted upon. He quite agreed with Mr. Proud that it was desirable to get the contract with the Municipality settled as soon as possible, assured that it would be of material benefit to the company.

The CHAIRMAN said he could assure Mr. Thorpe that the importance of strict economy in the administration and working of the company was a matter thoroughly understood and appreciated by the board. As to the new crowns of the gasholders, the board had employed first-class makers to supply them,

and had also employed an inspector, who had examined them, and taken care that the quality of the plates was such as could be relied on. With reference to the fittings, there had been between £3000 and £4000 worth of them sold this year, and the board had reason to believe that the demand would still continue. He might also state that the board did employ the telegraph with great advantage, and that the opening of the Suez Canal had been, and would be still, of essential service to the company. As to the supply of coal, if they could continue to get it at Bombay at the same price lately paid for it, it would be a great assistance to the dividends of the shareholders. The board had had in consideration the propriety of chartering steamers, but there is a difficulty in unloading in time. It must be borne in mind that Bombay was not like Liverpool, and other large ports of this kingdom, where ships could enter a dock or run up to a jetty and unload their cargoes. There they were all unloaded in the open harbour, and the whole of the coal had to be transhipped to lighters. There was a railway siding, but the company had not been able to utilize it for their purposes, the charges being so high. Coal in this country cost them 6s. 6d. per ton, but they had to pay as much as 4s. 9d. per ton in Bombay to get it out of the ship and put it into the works. Mr. Proud's statement that a large portion of the coal sent out had arrived there during the monsoon had taken him entirely by surprise. The directors had always been anxious to avoid such a thing, and endeavoured to regulate matters accordingly. It might very well be that with ships going out from England to Australia, and there taking in a cargo of coal for Bombay, there would be a degree of uncertainty about the time of their arrival; but the board had always made their calculations so that the vessels should reach there in the proper season. With regard to the contact with the Municipality, the terms of it had been accepted, but the contract was not yet signed. The board have pressed the matter upon the Municipality. As to the retorts, the board had largely changed the system, both in the form of benches and retorts, and they did not anticipate the same loss as heretofore, for doubtless the intermittent system of lighting, which necessitated the letting down of a certain number of retorts every month, had had a very serious effect upon the charges under this head.

Mr. Stokes asked whether an inducement might not be given to the Municipality in a reduction of price to light the public lamps every night.

Mr. Stephenson said the present proposal to them was based upon that. There were only five nights omitted in the month, and when Mr. Proud spoke of the intermittent system, it must be remembered it was only a question of degree, for there was hardly a town in this country where the lighting of the public lamps was not omitted for a certain number of nights about the full of the moon.

Mr. Proud said in this country it was not attended with the same results, because the public lighting here was not as in Bombay one-half of the consumption.

Mr. Stephenson said the Bombay Company had gasholder room largely in excess of any company in this kingdom, and they did not admit the evils of the intermittent system to the extent Mr. Proud did.

The motion was then put, and carried unanimously.

On the motion of Mr. Collier, seconded by Mr. Stokes, the Chairman, as one of the retiring directors, was unanimously re-elected.

The Chairman said he felt much gratified by the kindness of the proprietors in re-electing him. They might rely upon it that he would perform his duty to the company faithfully and honestly; and he hoped and believed they would live to see a brilliant future for the Bombay Gas Company.

On the motion of Mr. Thorpe, seconded by Mr. Proud, Major Gordon, the other retiring director, was unanimously re-elected.

Major Gordon thanked the meeting for this proof of their confidence in him, and pledged himself to continue his exertions in promoting the best interests of the company.

On the motion of the Chairman, a resolution was passed fixing the remuneration of the auditors at 25 guineas each for the past year.

The Chairman moved, and Mr. Collier seconded, the re-election of Messrs. Bradley and Deeley as auditors, which was carried unanimously.

On the motion of Mr. Stokes, a cordial vote of thanks was given to the chairman and directors for their careful management of the company's affairs.

The Chairman said he had much pleasure, on behalf of his colleagues and himself, in expressing his obligations to the proprietors for this mark of their approbation, and to assure them that they would do their best to deserve a continuance of it.

A vote of thanks to the engineer and manager in Bombay was then adopted, and the proceedings terminated.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page* 489.)

Mr. Morton read the following paper:—

ON SUNDAY LABOUR.

During the past twelve months a few of the gas managers in and around London have met together from time to time to discuss the subject of labour in gas-works on the Lord's Day. These discussions have led to the belief that a great deal may be done towards lessening that labour, and that the difficulties, which we were all more or less inclined at first sight to think insuperable, were really to a great extent more theoretical than practical, more imaginary than real.

I have been requested to bring the question before this meeting, with a view to having these difficulties or objections more fully ventilated, and, if possible, overcome; and I think it will be far from creditable to us as a body of professional men if we cannot devise some means, and as Christian men, if we do not use these means, so that our stokers may enjoy a much greater immunity from Sabbath labour than they do under existing arrangements. I say stokers, and I must be understood throughout this paper to refer only to carbonizing work, for I look upon all other as perfectly unnecessary, although it is a fact, and a fact very much to be regretted, that some managers do permit a considerable amount of such work to be carried on, not exceptionally, but as a rule. I think such gentlemen stand very much in their own light by so acting.

I believe that if we were all more alive to our *duty* to our men, difficulties would not appear so formidable, and that till we are thus alive they will not be dispassionately considered.

I do not believe that there is any one here who will deny that, even on the low ground of expediency, it is good policy to allow workmen to rest one day in the week, and when I put it to you from the higher ground of God's command that man should rest, I give a double reason why you should not turn from the consideration of this subject with impatience, or as unworthy your notice.

It is said, and to a large extent said truly, that the men would rather work than lose their pay. I would ask, who is responsible for this low state of morality? Who but ourselves, who have created or continued the bad custom, which, like every other bad habit, is very difficult to break off.

It is said again, that to cease working will materially affect the profits of the concern. This has been gone into carefully, and I am satisfied that the loss has been much over-estimated; but assuming for a moment, and for argument's sake, that there is a loss, I hold that it is not such as ought to deter us from at least taking a step in the direction indicated, and I am glad to say that several of us here have been encouraged by our directors to run the risk of any loss, so that it may be seen whether the end may not be attained.

In answer to queries sent to some 400 gas managers by the gentlemen referred to at the beginning of this paper, several managers say want of storeage room prevents them. As that difficulty can only apply to a part of the year, I would ask those whether they take advantage of the ample storeage they have in summer, and curtail their Sunday labour then?

In some cases I find this argument cuts the other way, and, where storeage is small, the gas made on Sunday is of necessity very much less than on week days, the consumption, as a general rule, being much smaller than on week days.

The questions of damage done to retorts by being left out of action; the risk of bad gas getting into the holders; the waste of fuel in maintaining the heats; the waste of gas when the retorts are first charged after having been left off, will doubtless be brought forward. I am far from saying there is nothing in them; but as the object of this paper is not to anticipate but rather to elicit discussion, I simply state them as points to be debated, and leave anything I may have to say regarding them till afterwards.

Having thus briefly introduced the subject, and believing it to be one well worthy your consideration, I trust you will thoroughly discuss it, and I believe the discussion will lead many to give more heed to it than they have hitherto done, and I am sure much good practical benefit will be the result.

Mr. Methven said he was very glad Mr. Morton had brought forward this subject, and hoped it would further the desire which many felt to give the stokers the day of rest they had not hitherto enjoyed. He knew there were serious difficulties in the way; the want of storeage in many works was not everything, and that might be overcome. Some one had said that a little experience was worth a great deal of theory. His own experience in this matter was that he could give his stokers one Sunday in three during the winter, and every other Sunday during the summer. The difficulty he had in the winter was that, though the amount of labour in the retort-house was reduced as much as possible, it was necessary to have some relays, and where to get them he could not tell, as there were not always stokers out of employ to put on the work. In many small works in various parts of the kingdom the directors never seemed to think of giving the stokers a Sunday to rest; they were anxious about their dividends, and nothing else. They paid the men for working seven days in the week, and never made any inquiry into their condition. He was convinced that gentlemen occupying the position of consulting engineers to gas companies might help forward this work considerably, and if they would take a little trouble in the matter many of the difficulties surrounding the question would be removed. Managers of large metropolitan works would find it more difficult to deal with than managers in the country, but if there were an earnest desire to accomplish the object, it could be done to a greater extent than at first sight might be supposed.

Mr. Parlby (Aylesbury) rejoiced that the subject had been mooted, for he was persuaded that the question of Sunday labour could not be too seriously considered by the members of the association. In the autumn of last year a number of inquiries were made by certain persons connected with metropolitan gas-works, in order to elicit information respecting it. At the time he received their circular he was the manager of some gas-works in Wales, where a small number of stokers was employed. From his experience there he found it extremely difficult, in the winter season, to carry out any efficient arrangement so as practically and materially to reduce the amount of Sunday labour. This arose from the limited and inadequate storeage resources. The greatest demand for gas was on the Saturday night, when the increase in stock from the week's manufacture was nearly distributed. This involved the necessity of Sunday labour, with little or no diminution, in order to make up the loss of stock to meet the requirements of the following week. In such a case there appeared to be no remedy, except by increased storeage room and additional carbonizing power. In most instances, an enlargement of the works under such circumstances directors would not be willing to undertake, and therefore the men must toil away on Sunday with the same—if not with greater—energy that was required every week day. But where the grievance could not be remedied, gas managers were discharged from responsibility in the matter. In the town where he was now engaged the difficulties were not so formidable, and he was able to give his men the greater part of the Sunday. To a large extent, he feared, the chief difficulty, in many works, arose from the little importance attached to the right observance of the Sabbath; but he hoped, the subject having been brought so directly under the consideration of gas managers, it would receive from them that attention which it deserved.

Mr. G. Livesey said the question was one which eminently deserved the attention of the association. The point they had to consider was the nature and the extent of the obligation laid upon them. He was afraid it was too much the habit with some of them to regard this matter as one in which no action was practicable, and that things must take their course, and go on in the same miserable way they had done for many years. If the conviction arose that it was their duty to do all in their power to ameliorate the condition of the men, no doubt means would be found to give effect to the purpose. The meetings held in London during the past year had disclosed this fact. A great number of difficulties had been started in the circulars, but the replies received had shown how many of those difficulties had been overcome. One manager would suggest a difficulty which the reply of another proved could be, and had been surmounted. In the case of the metropolis, one of the companies supplying the City had very little demand for gas from Friday night till Monday morning, and in that case they were actually compelled to cease working to a great extent. If the men came to work there would be no work for them to do, and therefore they were obliged to shut off the retorts, and means were taken by the engineer to prevent the possible deterioration of the retorts. The objection raised that the men would rather work than lose a day's pay might easily be dismissed. In his own works the Sunday holiday movement was said to have been started. He did not know whether such was really the fact; if so, the credit was due to his father. At those works they first gave the men a holiday once a month—not stopping the works, but getting other men in to take their place. This, of course, was not stopping Sunday labour at all. They afterwards went further, and gave the men a holiday once a fortnight, part of the men being away on the Sunday and part on the Monday. But it did not work well; for those who were away on the Monday would stop away on the Tuesday. They then stopped the holidays, and gave the men 4s. 6d. instead, telling them that if they took the holiday they must lose the day's pay. There was a difficulty in asking directors to pay men when they did not work. The yard men were not paid on the Sunday, nor was it considered that they had any claim to it. One day's rest in seven was a Divine institution, as old as the creation; and if it was a duty to take means to secure that rest, the men must be content to forfeit the day's pay. The Evangelical Society asked permission to hold religious service at the works with which he was connected. That permission was given, and work was suspended for two hours during the Sunday, for the purpose. The men appreciated the opportunity thus afforded them; but, after all, this was a poor substitute for a Sabbath Day's rest. In works where clay retorts were used it was not easy to arrange for suspending work on Sunday, but where, as in the case of the South Metropolitan Company, brick retorts were used, the work could be stopped and resumed without losing the greater part of the gas at the next charge.

Mr. Dunning said before the circular was received at Middlesborough a custom like that just described had grown up, not from any organized system, but the men had been told to make enough gas for Monday, and then to take all the rest they could. Their money was paid them for the week's work, and the consequence was that only about half of the men were there on the Sunday. They made a long shift on Saturday night, and until six o'clock on Sunday morning, and the men who were there on the Sunday made a little gas, kept

the retorts going, the fires being banked up, and, generally speaking, there was no outcry about the hardship of Sunday labour. He agreed with Mr. Livesey that the use of brick retorts would help them considerably in this matter. If managers would make a little effort, and were willing to allow their stock to run a little low for Monday morning, they might, by working the men up to six o'clock on Sunday morning, be able to give some of them the whole of the daytime for rest. He had not much fear that the men would abuse the privilege, though, of course, there was a danger that some of them would get out drinking; but if the men, though resting, were supposed to be on duty, and in readiness to be called upon if necessary, a check would be put upon the evil thus apprehended.

Mr. WARNER was glad to find that the consideration of these social questions was not ignored by the members of the association. He suggested that the subject should be referred to the committee to whom the propriety of forming a benevolent fund had been remitted, with instructions to make inquiries and report to the next meeting whether the thing was practical.

Mr. DOUGLAS did not think there would be any difficulty in the retorts standing for some time; the real difficulty was in the extra expenditure which the abolition of Sunday labour would involve.

Mr. MARTIN (Ormskirk) said the principle was a right one, that the men were entitled to their Sabbath rest, and if it occasioned extra cost, that must be borne by the consumers.

Mr. SIMPSON (Rugby) said he had had the management of works for years, and never had the least difficulty in giving his stokers a half holiday on Sunday. Nor had he ever had any difficulty with the men in reference to stopping their money; the men were always glad when it was their turn to be off. He supplied 110,000 cubic feet of gas on Saturday nights, and though he had only 60,000 feet of storeage, he had never any difficulty on Monday morning, the demand during Sunday being very small. In many gas-works it was the rule to employ the Sunday in putting to rights anything which had gone wrong on the works; but with him it was the rule not to increase his ordinary manufacture nor to do special work on that day.

Mr. SOMERVILLE seconded the motion made by Mr. Warner with great pleasure, because the subject was one which he thought should be well ventilated. Gas managers were often called over the coals about Sunday labour, and certainly for many reasons it would be desirable if it could be abolished or reduced. The last summer he was at Maidstone he did it for six months, and he fully believed that in works of that size (120 retorts in winter and 60 in summer) there should not be the least difficulty in the matter. The arrangement he made was that if the stokers produced the quantity of gas required for the six days of the week, he would give them the seventh day to themselves, without decreasing their wages. The men took care to make the gas, and, with the exception of one man to look after the fires, the rest had the holiday. He never found anything wrong with the retorts; they were not burnt out, and he had no bad gas on the Monday. The retorts were a little duller in heat, and the men had to come a little earlier to attend to them. The coals were kept in during the whole 24 hours, and one advantage was that all the carbon was burnt off the retorts.

Mr. HODGSON JONES asked whether there was a gas-tester in the town.

Mr. SOMERVILLE said there was, and rather a severe one.

Mr. JOHN METHVEN: Did you stop the exhausters?

Mr. SOMERVILLE: Yes; the lids of the retorts were slacked; the exhauster was stopped about three hours before the last retort ought to be off, so that there was not the least danger.

The PRESIDENT said he thought it was a very good suggestion to adjourn the consideration of the question, and to refer it to the committee already appointed to glean such information as could be obtained before the next meeting.

The motion was put, and carried unanimously.

Mr. MORTON said he was pleased to find that the paper he had read was so well received. With regard to Mr. Methven's suggestion about having relays of men to supply the place of those who took the holiday, that was not lessening Sunday labour at all. For some time past at the London works he had shut off one-third of the retorts on Sunday, thus giving the men who worked that section the opportunity for rest. They were simply told that they would not be required till Monday morning, and they made no difficulty about the work being stopped. At those works the custom was to give a holiday once a fortnight during the summer, and once a month during the winter. The men entitled to their holidays were included in this batch, so that not the whole of them lost their pay. To prevent damage to the retorts, the plan adopted was to leave the coke in, with the lids screwed up, and to open a hole in the hydraulic main, a valve being shut off between that and the exhauster.

Mr. E. GODDARD (Ipswich) read the following paper:—

ON THE APPLICATION OF GAS TO GENERATING STEAM.

The subject of my remarks, the application of gas to generating steam, is one which, if judiciously carried out, may become of great importance to gas companies, in securing an increased consumption of gas in the daytime, and also of great value and convenience to the public. There are many localities and trades where steam power is greatly needed, and where, if it could be applied, it would add greatly to the productive power of the country, and to the reduction of manual labour.

The great obstacles to the use of steam are the danger attendant upon the fuel employed, the want of space, and the cost of boiler-setting and the erection of shafts, together with the objection raised by landlords in consequence of the difficulty of effecting insurances except at high rates of premium.

The want of space in many of the metropolitan buildings as to where a steam-boiler could be fixed is a sufficient consideration to prohibit the use of steam power, where but for this circumstance it could be most advantageously applied. Attempts have been made from time to time to obviate these difficulties by the application of gas. The adoption of gas-engines has to some extent removed the objection, but not altogether so, but an ingenious invention patented by Mr. Arthur Jackson, and carried out by Mr. Thomas Middleton, the enterprising engineer of Loman Street, Southwark, has recently come under my observation, which to my mind has most effectually removed the difficulties to which I have referred.

The invention consists of a vertical tubular boiler so constructed as to possess great power of generating steam, but of very small dimensions; the tubes are not more than 1-inch bore, and are placed very close to each other, so that an enormous heating surface is obtained; beneath the tubes, on a revolving plate, are a number of atmospheric burners, each supplied with a cock, so that the heating power is completely under control, and can be increased or diminished at pleasure as more or less power may be required.

I have on the table before me an arrangement of burners intended for a 4-horse power boiler, and the diagrams upon the walls will fully illustrate the construction of the boiler, but I may further remark that the space required for a

½-horse power boiler is only	17	inches.		
1	"	"	23	"
2	"	"	36	"
3	"	"	42	"
4	"	"	48	"

No flue or chimney being required, the boiler may be placed outside any building, either in the area or on a platform projecting from the top storey of the highest building.

The time occupied in getting up the steam to 40 lbs. or 50 lbs. to the square inch for a 4-horse power engine is from 20 minutes to 25 minutes. A very small modicum of gas is required to maintain the pressure of steam when the engine is at rest, and hence the value of the invention is greatly enhanced where intermitting power is required—such, for instance, as is the case in working hoists in warehouses, hotels, buildings in course of erection, &c., &c., and particularly as the full power may be almost instantaneously restored when needed; and when the work of the engine is continuous, the pressure of steam may be maintained at its maximum with the greatest uniformity, without a particle of steam being wasted.

I have had an opportunity of inspecting several of these patent boilers now at work, and I find upon inquiry the average consumption of gas per horse power per hour to be about 100 cubic feet.

I have been furnished with the results of an experiment very carefully made upon Jackson's patent boiler, now at work at Wool Quay, supplying steam to a 2-horse power engine. The quantity of water used was 27 gallons, which was raised from a temperature of 67° to 212° Fahr. in 13 minutes, the consumption of gas being 60 cubic feet. The lightness and portability of a boiler of this description, if placed upon a carriage, would be of great utility in a gas establishment for steaming out apparatus in any part of the works, or any portion of the street-mains which may be blocked by the deposit of naphthalene, and which could be worked without the slightest danger or inconvenience to the public.

I think I have said sufficient to awaken the interest of the association on this subject. The great merits of this invention are—first, economy of space; secondly, economy of labour and fuel; and thirdly, the perfect freedom from risk of conflagration—merits which I am sure will be appreciated by every gas engineer present, and recommended wherever an opportunity presents itself of increasing mechanical power by the application of gas.

Mr. SHARP (Southampton) said for many years he had made a boiler similar to the one described, and a very large one was exhibited in the Exhibition of 1851. He had always used it in cooking, and it was really surprising how the steam was kept up with so small a quantity of gas. Certainly he had not used an atmospheric burner, but after the steam once got up the flame might be turned down to a blue speck, and still steam would be generated. This showed the advantage of the tubular form of boiler, which exposed so large a surface to the action of the heat. It would be a great advantage to many parties if boilers of the sort described came more generally into use.

Mr. Plumb and Mr. Hutchinson having been appointed scrutineers of the votes for the election of the committee for the ensuing year, the proceedings of this sitting terminated.

The members reassembled at seven o'clock in the evening—G. ANDERSON, Esq., in the chair—when the following lecture was delivered:—

PHOTOMETRY AS APPLIED TO THE ESTIMATION OF THE VALUE OF COAL GASES.

By Messrs. T. N. KIRKHAM, C.E., and W. SUGG, A.I.C.E.

Deeply sensible as we are of the honour you have done us in asking us to deliver the customary evening lecture, yet, finding it no easy task to fulfil, we are induced to ask your kind consideration for us in our efforts to place before you all that is known up to the present time of a science peculiarly interesting to managers—viz., that of photometry, as applied to the purposes of gas lighting. In his first lecture, at Manchester, in 1864, Dr. Letheby gave a short description of his photometer, as fixed at Jewry Street, City; and Mr. Barlow, on May 24, 1866, read a paper to you upon the registering jet photometer.

This is all the information you have had officially placed before you upon this most important subject, and it is the intention of my colleague and myself in this lecture to give you a condensed epitome of all that has been done in this branch of philosophic science since the commencement of gas lighting up to the present time, so that you may be in a position to realize the entire question, and be in a position to judge for yourselves what is best to be done in order to obtain that desideratum—an uniform standard of measurement of the illuminating power of coal gases. The want of this standard is felt more and more as the science of gas lighting advances. In the early days of gas lighting, it was sufficient for the gas manager to know how much gas could be produced from a ton of coals, and the cost of production. Gradually, however, it has dawned upon the minds of municipal authorities and consumers generally that something more than mere quantity is required in the supply of gas. Quality and purity have become, if not household, at least "parliamentary words," and it is now usual, whenever companies are before Parliament for increase of capital, or further powers of any kind, for the municipal authorities to put on the screw in their best possible manner to obtain an extra candle or two in the illuminating power proposed by the company, as well as a reduction in price, and thus obtain a double advantage. And even if there is no opposition such as this, yet the gas manager, in making his report of the working of the establishment under his charge, must state not only the quantity of gas he can produce, but also the illuminating power of that gas, in order that his work may contrast favourably with that of *confrères* in other establishments. In addition to all this, we have in the City of London and the Dublin Gas Acts a new phase in gas legislation, which may be taken as a precedent in prospective cases, and imperatively commands our attention to the subject of how the illuminating value of gas is to be determined; for it is proposed to exact heavy penalties in every case in which the company fails to supply gas not up to the standard fixed in their Act.

Already questions have arisen upon this subject, and it is for us to examine it well, and be prepared to state what is a just and reasonable mode of examining the quality of the gas, so that both buyer and seller may be mutually satisfied.

At the outset, the science of photometry, as applied to gas, divides itself between two systems. The one by which it is sought to measure the illuminating power of a gas by means of some property peculiar to itself; the other, by which the amount of light produced from the gas under examination is compared with some other artificial light.

The first-mentioned section includes within its limits such photometers as the—

Lowe's jet photometer.
The various duration tests, Dr. Fyfe's, or others.
Erdmann's "Gas-Prover."
Chambeyron's photometer (see "Clegg," 1859 edition, p. 363).

And the second section those of—

Wheatstone, Bunsen, Letheby, Ritchie, Arago;
Church and Mann;
Rumford, Foucault, and Evans.

As this lecture is not intended to be a history of photometry, but rather an explanation of what it is, and how it applies to the manufacture and distribution of gas, we shall not deal with the subject in the chronological order of the invention of the various photometers, but as it ranges itself under the two heads mentioned above.

First, then, the simplest—viz., that system which proposes to measure the illuminating value of the gas, not by comparison with other artificial lights, but by certain physical phenomena peculiar to each quality of gas.

One of the most admired of these was certainly the bromine test, because it seemed that a chemical experiment which could always be performed in the same manner, and with instruments made upon one model, must necessarily give true results, being quite independent of faults of vision or irregularities in the working of apparatus. The principle upon which the system is founded is common to other systems, and is this—"The gas which will give the highest illuminating power is that which contains the most carbon." To find the quantity of carbon in the gas is then the object of the bromine test.

Bromine is a metalloid, and at ordinary temperatures is of a deep brownish red colour. It is liquid, and boils at 113° Fahr. Its specific gravity is 2·97. Its vapour resembles that of nitric acid, but has a peculiarly disagreeable pungent

smell. It is poisonous, and acts so strongly on the lining membrane of the nose, that smelling a bottle of bromine is often followed by painful irritation of the nostrils, attended with a copious flow of tears lasting for hours or even for days.

Such is the description of bromine. The method of performing the experiment is as follows:—

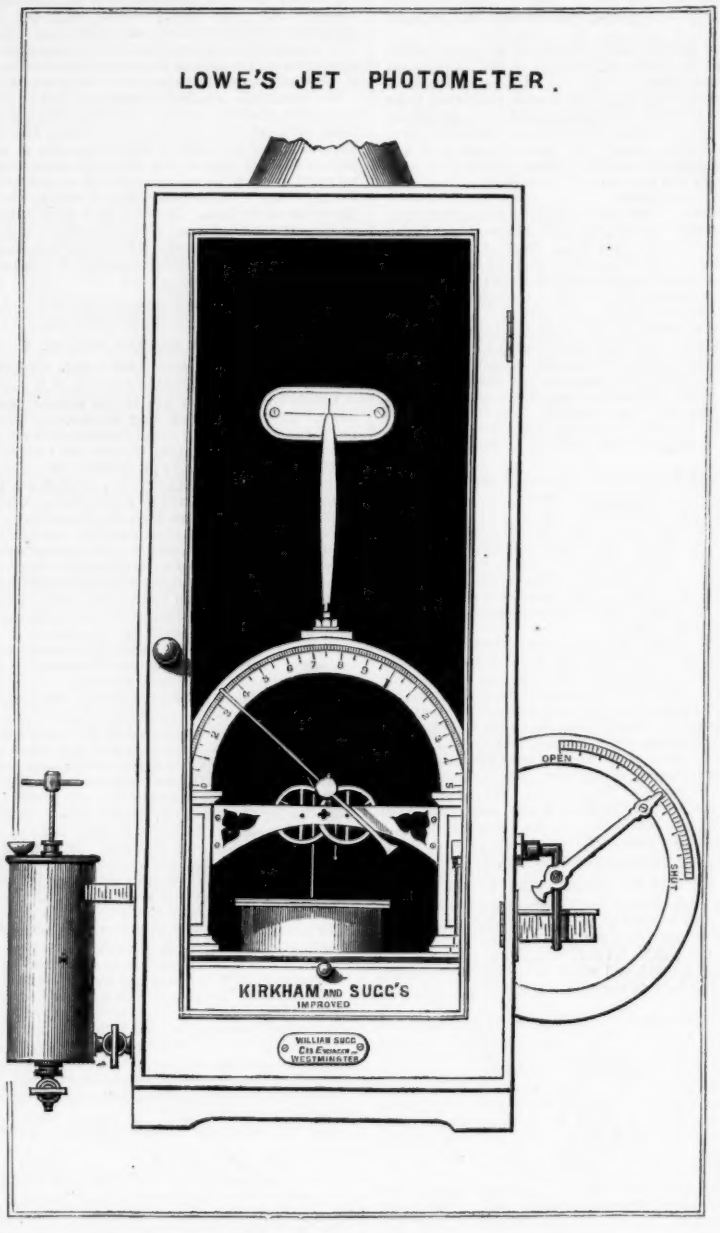
A Cooper's tube is filled with gas, and a small quantity of bromine is introduced, and the whole shaken up together. Any excess of bromine is neutralized by the introduction, after condensation has taken place, of a little caustic potash.

The amount of condensation is greater or less according as the gas contains more or less carbon. The value of the degrees of condensation having been once definitely settled, it would appear to be only necessary to perform this apparently simple experiment to determine without doubt the value of the gas under examination.

Its advocates, however, have reluctantly been compelled to abandon it, because, although it absorbs hydrocarbon vapours, so it does other things as well, and its indications are therefore now considered to be valueless. It may be mentioned that the vapour of bromine is not an agreeable thing for operators at all careful about their throats or lungs. If it had been a successful system, the science of photometry might have had its martyrs as well as others.

LOWE'S JET PHOTOMETER

might, perhaps, have taken its place first, if the subject were considered in the chronological order of the invention of the instruments of photometry, because it seems that several persons claim to have made use of such an instrument many years ago, at the very commencement of gas lighting, *if not even before it*. They appear to be much annoyed that the name of George Lowe should be given to this instrument any more than the name of any of those who are said to have used it very long before he did. If there is any wrong done to any one in the naming of this instrument, it is for your humble servant to cry *peccavi*. Although the principle upon which it was constructed may have been discovered by other persons, it was nevertheless he who made it of any practical value; and it is indebted to my colleague and myself for those improvements upon Lowe's instrument which have placed it in the position it now occupies in the estimation of gas managers. I trust you will not impute to us any idea of unduly praising ourselves, but it is advisable to clear up as we go on, so as to prevent misapprehensions in future.



The principle upon which it works is exactly the same as that of the bromine test—viz., that the richest gas contains the most carbon; to this is added the words, "and requires the greatest quantity of oxygen for its combustion."

It will be seen that this principle is applied to another instrument which operates in a different manner to arrive at a solution of the question—viz., Erdmann's gas-prover, which will be explained in its proper order.

Lowe's theory is substantially this: A jet of gas issuing from an orifice of fixed dimensions under a constant pressure, and requiring a certain amount of oxygen for its proper combustion, must necessarily, if the gas contains a greater quantity of carbon per cubic foot, produce a longer flame than that which contains a lesser quantity, because it must go higher to come in contact with that oxygen. Thus the richer the gas the higher the flame.

Now, in order that every quality of gas may be estimated under the same circumstances, Mr. Kirkham and myself have found it more convenient to substitute for his theory this, which amounts to the same thing in the end—viz.: Maintaining a 7-inch flame from an orifice of certain fixed dimensions, the illuminating power of gas is in direct proportion inversely as the pressure.

To explain this popularly, we refer you to the diagram of the jet photometer arranged for the use of these instruments. By inspection it will be seen that it is ruled off in lateral and longitudinal lines; the former corresponds to the illuminating power of the gas in candles, the latter to the pressure required to give a 7-inch flame. This is the height of flame which we have adopted as standard for gases of from 9·6 to 22 parliamentary sperm candles, six to the pound, burning at the rate of 120 grains per hour. Thus, then, it will be seen that at ·63 pressure, 14-candle gas with our standard jet gives a flame of 7 inches in height; that 12-candle gas requires ·685 pressure to give the same height of flame; that 16-candle gas gives the standard flame at ·575 pressure; that 20-candle gas gives the standard flame at ·465 pressure, and so on for all other qualities of gas within the range previously stated.

So that to ascertain at once by simple inspection the exact illuminating power of any gas to be examined by the aid of this instrument, it is only necessary to adjust the height of the flame to 7 inches, note the pressure required, consult the diagram, and read off the answer in sperm candles without further calculation. Now, you will naturally say, "Yes; this is all very well, but what proof can you give to substantiate your theory?" Before answering this question, it is necessary to premise that this theory, like many others, was not thought out first and afterwards proved by experiments, but that, on the contrary, the theory was constructed upon the tabulated results of experiments conducted for another purpose. We might even say, if you will pardon the simile, that our object was to convert the indications of the Lowe's jet into sperm candles and carcel lamps; but, like the Zulu Kaffirs did in the case of a celebrated calculating hierarch of the Church of England sent over for their benefit, Lowe's jet converted us. Thus its correctness claims our assent to the fullest extent to which truth can be demonstrated by induction.

My colleague and myself had undertaken a rather long series of experiments for the purpose of determining the relative value of the English and French standards of illuminating power, the particulars of which will be communicated to you in their proper order, and very early in our first series we were led to remark the regularity with which a Lowe's jet photometer, which was supplied with the same gas as that upon which we were experimenting, answered to every increased per centage of richer gas added to the ordinary gas we had prepared. We therefore decided, after having carried out the first series, to commence a second series, in which we used two Lowe's jet photometers, made precisely alike, and connected to and supplied with the same gas as that burned in our other photometers, which were the "cross" photometer and the Foucault photometer, both here exhibited.

In order to save confusion, we must ask you to assume for the present that which we shall doubtless amply prove to you in another part of this lecture—viz., that the system adopted by us in our experiments upon the standards of light, was the best possible to arrive at the truth.

Four operators at the cross photometer made simultaneously an estimation of the illuminating power of the gas as compared with sperm candles, in the ordinary manner adopted by gas examiners. For better security they repeated this twice, making in all twelve experiments. Upon a diagram prepared precisely in the same manner as this one, but without the red diagonal line, was marked the average result of these twelve experiments, care being taken that the mark should be put on that lateral line corresponding to the illuminating power in candles (as found) at its intersection with that longitudinal one, corresponding to the pressure required to give a 7-inch flame, with the same gas burning in one of the Lowe's jet photometers. Thus the mark for 14-candle gas was put upon that longitudinal line marked ·63, and opposite the figure 14. The black quatrefoil is the mark. The second Lowe's jet was kept at a constant pressure, the height of the flame rising as the quality of the gas increased. This diagram shows the position of the several instruments.

Simultaneously with these experiments a fifth operator made three experiments with the Foucault photometer, which is fitted in the same manner as those employed by the municipality of Paris for the verification of the gas supplied to that city. His operations were conducted nearly in accordance with the instructions issued by the municipality as a guide to their gas examiners.

The average of these three experiments was marked on the diagram in that position, as regards illuminating power, corresponding to the value of the gas according to the French system, in the terms of the English standard candle. The red star is that mark.

A sixth operator took charge of the Lowe's jets, and observed the pressure required to give a 7-inch flame with each of the different gases examined. He also noted the time required for the consumption of ·1 of a cubic foot of such gas.

These results, we consider, clearly demonstrate the truth of our theory, for by no known law of physics can any other line be found, from an examination of these experiments, than that laid down by us.

It will be observed that there are a sufficient number of experiments of both kinds which fall on the line to justify us, without mentioning those on either side of it, which are also very conclusive.*

* An enlarged coloured diagram of these experiments is published for the use of operators testing with Lowe's jet photometers.

Erdmann's Gas-Prover.

We must now rapidly glance at the Erdmann's gas-prover, and, to justify the shortness of the time which we shall devote to it, I shall take the description and opinion of its value given by Mr. Schilling, the talented director of the München Gas Company, in his "Traité d'Eclairage," a work which corresponds to our own "Clegg on Gas Lighting."

It consists of a Bunsen burner arranged in such a manner that the supply of air is admitted through a long narrow slit. A scale attached shows how far it is open, and, from the size of this aperture, it is sought to establish the rate of the passage of air demanded for the perfect oxidation of the gas burning at the top of the burner; and from this, according to the theory before mentioned, that the richer the gas the greater the quantity of air required for its perfect combustion, to determine the illuminating power of the gas.

Mr. Schilling considers that the instrument requires meters or other apparatus to measure exactly the quantity of air and gas burned together in order that its indications may be of any value whatever, and, from a number of carefully conducted experiments published by him—which, if time had allowed, I should have been pleased to place before you—he demonstrates that it is not at present a reliable instrument.

Mr. Friedleben, of Frankfort-on-Maine, has in his gasograph remedied in theory some of these defects, although his instrument has not within itself those elements of precision which are demanded by self-photometers such as these. The instrument is here at work, and it consists of a revolving vertical dial, which turns on its axis once in twelve hours. A very small meter in the interior gives motion to a piece of apparatus, by which at every revolution a hole is punctured in the paper. The number of points per hour bear relation to the illuminating value of the gas.

A very pretty little instrument, a modification of Erdmann's gas-prover, was exhibited at the Exhibition of 1862, by Mr. S. Elster, of Berlin, which certainly amended all the faults in the original invention.

In consisted of a small gasholder, with a very beautifully made and large scale attached to it.

The contents of the gasholder were about half a tenth of a cubic foot. Into this gasholder was admitted a quantity of gas, and the rest of the holder was filled with air. At the base of the holder, and connected thereto by means of a short tube, was fixed a burner with a number of holes, somewhat in form resembling the rose of a very small watering-pot. The gas and air was allowed to burn in this burner at a certain height, when, if it was perfectly oxidized, and burned with a perfectly blue flame, the quantity of air which had been admitted to the holder was taken to represent, by comparison with a specially prepared table, the illuminating power of the gas; if, on the contrary, the gas burned with a white tip, or was too much oxidized, the gasholder was emptied, and the trial repeated till the result of complete oxidation was obtained.

This may be termed a tentative process, and I took the liberty, in conversation with Mr. Elster, to observe to him that however good it might be, it was an instrument requiring great care on the part of the operator—a mistake might result in an experiment upon the explosive force of certain mixtures of gas and air of a very unsatisfactory nature to the operator—but he could not see it. Probably German operators never make a mistake, or are too absorbed in their scientific experiments to let the thoroughness of their investigations be interfered with by their personal inconvenience. Nevertheless, if this system of burning the gas with air be of any use to us, this method seems to be the right way of employing it.

The duration test is said by some to have originated with Dr. Fyfe, but this is not substantiated that we are aware of. The very idea, however, bears the stamp of a shrewd North Briton. It is still founded on the theory that the richest gas contains the most carbon, but we have no mention of a chemical analysis to find how much carbon there is in it, but this shrewd practical question—How long will it burn? And so we have this theory altered thus: Issuing from a constant orifice at a constant pressure, the *richest* gas will burn the longest time. This is, in fact, the true application of all photometrical tests, for to the consumer the advantage of an increase of illuminating power means, or should mean, a reduction of the quantity of gas required to light his house with the same amount of light he enjoyed before the alteration.

Careful examination of the theory shows, however, a radical defect in it, which exercises a very important effect upon the test, as well as upon the commercial result.

It is not practically true that richer gas issuing from a constant aperture, at a constant pressure, will burn longer than a poorer gas. Theoretically it will, but the difference between the richer and the poorer gases is so small that it is difficult to tell one from the other. Thus, a jet of 12-candle gas, burning on a jet photometer at a pressure of 6/10ths of an inch, consumed 2 cubic feet of gas in one hour. A jet of cannel gas, equal to 23 candles illuminating power, burning on the same instrument under exactly the same circumstances, consumed 1·9 cubic foot. At first sight this sounds anomalous, and you will naturally ask, "Then what is the difference between the two? And what advantage is it, then, to burn cannel gas?" Doubtless, to many of you, these questions are as familiar as possible. Consumers are constantly asking them. The difference in the two jets is in the length of the flame. With the 12-candle gas we get, perhaps, a 7-inch, and with the 23-candle gas we get a 9 or 10-inch flame. One more element must then be taken into consideration, and that is the height of the flame, and the theory must be altered as follows:—Burning from an aperture of fixed dimensions, a richer gas will supply a flame of a constant height for a longer period than will a poorer gas. It necessarily follows that a lesser pressure is required for the richer gas than for the poorer. Thus with poor gas we have a 7-inch flame at ·685, while with 22-candle gas we have a 7-inch flame with ·40 pressure.

These flames consume respectively 1-10th of a foot of gas—the 12-candle gas in 2 minutes 46 seconds, or a little over 2 cubic feet per hour; the 22-candle gas in 4 minutes 12 seconds, or 1·45 cubic foot per hour. The difference between the two is 55-100ths of a foot of gas per hour, or at the rate of 5·5-100ths of a cubic foot of gas per candle, if the decrease per candle is in direct proportion, which you will perceive it is not; but this is near enough for the purposes of explanation. It has therefore appeared to my colleague and myself that the duration test may be employed in conjunction with the jet photometer in three ways, either of which may be made self-registering, and may be attached to any jet photometer fitted upon our new system. Thus an apparatus similar to the one here exhibited, which is simply this: A flat paper dial is made to revolve by means of an 8-day clock, with a heavy 40-inch pendulum. An electro-magnet with an armature is fixed at one side of it, and the circuit of a current of electricity is completed through it every time the meter here completes one revolution, which is equal to 1-10th of a cubic foot. The armature is thereby attracted to the face of the magnet, and in jumping to it punches a hole in the paper by means of the point fixed to one end of it. Thus we should have 14·5 points in one hour with 22-candle gas, and 20·5 points with 12-candle gas, or ·6 of a point per candle.

Another instrument (which is here shown) for the same purpose works in this manner: An 8-day clock, with a 40-inch pendulum, is made to wind off a strip of paper from one wheel to another at the rate of about 2 inches per minute. A meter is made which, by a simple touch arrangement, completes the circuit of a current of electricity through an electro-magnet every time the 100th of a foot of gas passes through it, causing it to punch a hole in the paper as it passes along. Another electro-magnet punches a hole in the middle of the paper every minute, while a third does the same thing every hour. Thus, as before, for 22-candle gas we should find 10 points in 4 minutes 12 seconds, or 145 points in an hour, and with 12-candle gas we should find 10 points in 2 minutes 46 seconds, or 204 points in an hour. One is a slow instrument, and the other a quick one. The difference between the two is this, that while the slow instrument gives good practical results in an hour, and is sufficient for most manufacturing purposes, the quick one, which is more carefully constructed, will show the illuminating power of the gas in five minutes at most.

The third method of using the duration test is by attaching the meter registering tenths of a foot of gas to the latter-mentioned clock apparatus, and the result obtained on the paper will be the number of minutes and parts of a minute that a flame of 7 inches will be maintained with a tenth of a foot of gas. From such data the illuminating power of that gas may be ascertained by a reference to the diagram. For example, it is found that a 7-inch flame has been maintained in the jet photometer for 3 minutes 20 seconds by the consumption of 1-10th of a foot of gas, Question: What is the illuminating power of such gas? Answer: Referring to the diagram, we find, opposite the lateral line, 3 minutes 20 seconds, a little over 16-point 9-candle gas. Such a quality gas will do this, and no other.

Now to show how the jet photometer and duration test are combined in practice.

We will suppose that we have a gas under examination which gives a 7-inch flame at 5-point 6-10ths pressure. Referring to the diagram headed "Retrograde Scale," we find that the longitudinal line corresponding to 5-point 6-10ths cuts the red diagonal line on the sixth lateral line between 16 and 17 candles; the value of the gas is therefore 16·6 candles.

The corresponding duration test is found by referring to that part of the jet photometer diagram headed "Duration Test." Finding the longitudinal line corresponding to 5-point 6-10ths pressure, we follow it up till it cuts the red line. This we find it does at that lateral line corresponding to 3 minutes 17 seconds, which is the time a tenth of a foot of such gas ought to last. If the slow-registering apparatus is used, we should find 17 points on the paper in one hour; or, if the quick instrument is used, 172 points in one hour; or, on the third system, 1 point every 3 minutes 17 seconds.

But none of these self-instruments, however good they may be in themselves, are of any practical value to us, unless their indications can be compared with the standard adopted by the British Parliament, as a point of comparison from which to deduce the value of gas supplied to the public, and which is inserted in all Acts of Parliament relating to gas. That standard is a sperm candle of six to the pound, burning at the rate of 120 grains per hour. Naturally nothing can be more easy of comprehension to the British public than this, that a burner consuming *5* cubic feet of gas per hour shall give a light equal to a certain number of sperm candles.

According to the first and only official system of gas examination for illuminating power, which is that described in the instructions issued by the gas referees appointed under the City of London Gas Act of 1868, the time at which the tests for illuminating power are to be made fall within those hours during which the gas is likely to be most extensively consumed—from five to eight o'clock p.m. in winter, and from eight to ten in summer.

The average of a number of tests are to be taken.

The apparatus is to be constructed upon an improved model, and fixed in an approved manner, similarly to that set up in the office of the gas referees, and which is to be taken as a guide, and the entire apparatus when in use is subject to occasional visits of inspection by these officers.

It consists of a photometer, either on the Evans or Letheby system, arranged for two candles.

A meter with combination index, by which both the time and the consumption of the gas are simultaneously indicated on the same dial.

A delicate balance governor.

A King's pressure-gauge, showing the 100th of an inch, and fitted with an arrangement by which the pressure on the inlet and outlet of meter, outlet of governor, and at the point of ignition can be readily ascertained.

A standard burner, known as the "London" burner, No. 1 size, and fitted to take either a 6, 7, or 8-inch chimney. A delicate candle-balance capable of weighing to the tenth of a grain.

A cubic foot measure, for the purpose of verifying the accuracy of the meter from time to time.

As the *modus operandi* as described by the gas referees is very short, it will be best to take it from their printed instructions.

Mode and Times of Testing for Illuminating Power.

Until the end of September next, the testings for illuminating power shall be three in number, and shall commence at the following hours:—

For Common Gas.		*For Cannel Gas.*	
1st Testing	at 8 P.M.	1st Testing	at 8.30 P.M.
2nd ,, ...	,, 9 ,,	2nd ,, ...	,, 9.30 ,,
3rd ,, ...	,, 10 ,,	3rd ,, ...	,, 10.30 ,,

The photometers to be used in the testing-stations shall, until further order, be the improved forms of the Bunsen photometer, which have been certified by the referees. The burner to be used for testing the common gas of the Gaslight and Coke Company, the City of London Gas Company, and the Great Central Gas Company (which is required to have an illuminating power of 16 candles) shall be Sugg's "London" Argand No. 1, with a 6-inch by 2-inch chimney; and for the gas of the Imperial Gas Company and the South Metropolitan Gas Company (which is required to have an illuminating power of 14 candles) Sugg's "London" Argand No. 1, with a 6-inch by 1¾-inch chimney. If at any time the gas-flame tails over the top of the glass, a 7-inch by 2-inch chimney shall be used for the 16-candle gas, and a 6-inch by 2-inch chimney for the 14-candle gas. The chimneys must be cleaned daily, at the commencement of the testings. The burner to be used in testing cannel gas shall be Sugg's steatite bat's-wing No. 7. The candles shall be sperm, and two candles shall be used together. The gas in the photometer is to be lighted at least ten minutes before the testings begin, and shall be kept continuously burning from the beginning to the end of the tests.

Each testing shall include ten observations of the photometer, made at intervals of one minute. The gas is to be consumed at the rate of 5 cubic feet per hour. The standard rate of consumption for the candles shall be 120 grains each per hour. Before and after making each set of ten observations of the photometer, the gas examiner shall weigh the candles; and if the rate of combustion shall have been more or less per candle than 120 grains per hour, he shall make (and record in a book to be kept for the purpose) the calculations requisite to neutralize the effects of this difference.

These calculations are made by simple proportion as usual. The gas examiners are, at least once a week, to test the meter-clocks, by the standard clock in each testing-station, and corrections are also to be made for temperature and barometric pressure according to tables provided by the gas referees. The average of each set of ten observations is to be taken as representing the illuminating power for that testing. And the average of the three testings is to be taken as representing the illuminating power of the gas for the day.

Besides this the gas referees have taken a vast amount of trouble, and have made a very great number of experiments with a view of obtaining sperm candles of uniform quality capable of consuming the standard quantity of 120 grains with average regularity, and they supply to each gas examiner the candles which he shall use in his tests.

These instructions leave nothing to be desired either in the reliability of the apparatus or the correctness of the mode of procedure, and, indeed, afford an example of the most perfect system of testing which can be adopted in connexion with the present parliamentary standard.

But in order that the system of testing for illuminating power shall be conclusive as a scientific test, it is still desirable that they should carry their investigations further. The important question still remains unresolved—What is a sperm candle?

What is a sperm candle? And what is the just amount of light which ought to be obtained from the combustion of 120 grains of sperm per hour consumed by one of these candles? *Quis custodiet ipsos custodes?* By what standard shall we measure the standard?

It is here proper to mention that the parliamentary rate of consumption of sperm candles of six to the pound appears to be abnormal, for in the report of Messrs. Graham, Cooper, Brande, and Leeson, given in the Great Central arbitration case, page 223, we find the average consumption ranges from 130 to 135 candles. There parliamentary rate, therefore, must have been arbitrarily assumed.

Now we shall proceed to show you how we set about answering this question, by referring you to a set of diagrams, showing the results of a number of experiments made by my colleague and myself for this purpose. In the first place, we must tell you that to do this properly it was necessary to devise a special instrument. That instrument is before you, and it is called the "cross" photometer. It is, as you will see, a combination of the two most approved comparison photometers in general use—viz., that devised by Mr. F. J. Evans, the engineer-in-chief to the Chartered Gaslight Company; and that devised by Dr. Letheby, the chief gas examiner for London. Two of the arms of the cross are Evans photometers; the other two are Letheby photometers. It is so contrived that all the four instruments can be used simultaneously and independently to determine the illuminating power of the gas consumed by one burner fixed in the centre of the instruments, and equidistant from the candles, or other standards of comparison, placed at the end of each photometer. Each photometer is provided with plumb-lines, so that the flames of the candles, or other standards used, can be accurately placed at their proper distances. The diagram exhibits the cross photometer as it was arranged for making comparisons between the English and French systems, and it will be seen that for the purposes of this series of experiments two of the arms were supplied with French lamps, burning colza oil, and the other two with standard sperm candles. The instrument as it is now before you is arranged for candles at each photometer. The four photometers give each precisely the same results if tested by means of jets of gas of equal illuminating power fixed in the places usually occupied by the standard candles.

It will be seen also that a clock-meter, King's pressure-gauge, and a delicate balance governor is attached to the instrument, for adjusting and maintaining the quantity of gas to be consumed by the testing-burner.

Each photometer is also provided with a minute-clock and a balance, for ascertaining the consumption of each pair of candles during the course of the experiments.

Four operators can, therefore, at the same time test the same gas.

For the experiments we are about to point out to you, the *modus operandi* was as follows:—

Each photometer is distinguished from the others by a separate mark, and all experiments performed at that particular instrument are shown on the diagram by that mark.

These marks are a △, a +, a ○, and a □.

At the conclusion of every experiment each operator marked the result on a prepared diagram, ruled in the same manner as these.

The explanation of the ruling of the diagrams is as follows:—

The base line and the longitudinal lines ascending from it represent the weight of material consumed—one line to every grain, ranging from 118 grains up to 160 in diagram No. 1.

The lateral lines show the illuminating power, and correspond to the divisions on the photometer-bar, ranging in diagram 1 from 12 to 17 candles.

The strong black on all the diagrams encloses all those experiments in which the candles consumed within the limits of what are considered good experiments—viz., from 118 to 130 grains per hour.

Diagram 1, Plate 19.—Commencing with experiments Nos. 56 and 58. in No. 56, with a consumption of 119 grains, the illuminating power of the standard gas is represented as 15·3 candles; whilst in No. 58, with a consumption of 121·2 grains, it is 14·5 candles. The difference between these two experiments, made with candles which happen to be nearly within the parliamentary standard, is ·8 of a candle. In experiment No. 51, burning the normal standard quantity of 135 grains, the same gas is represented as being 15·48 candles; and in No. 61, consuming 134·4 grains, or ·6 of a grain less, it is shown to be 16·28 candles, the difference being in this case also ·8 of a candle. In experiment No. 60, with a consumption of 134·7 grains, or only ·3 of a grain more, the gas was shown to be equal to 18·18 candles, a difference of 2·70 candles. Thus candles, practically burning the same amount of sperm per hour, show a difference in the illuminating power of the gas of 2·70 candles. In experiment No. 51, with a consumption of 129 grains of sperm, the gas is shown, by the reading of the photometer, to have an illuminating power of 12·6 candles. In experiment No. 52, with a consumption of 145·2 grains, the gas appears, from the reading of the photometer, also to be equal to 12·6 candles. Experiment No. 52, with a consumption of 157·2 grains, shows the gas to be equal to 12·54 candles, by the reading of the photometer. The last three experiments were examples of candles consuming different quantities of sperm, yet giving the same amount of light, the correction of which to the parliamentary standard of 120 grains creates error. Experiments Nos. 57 and 54, each with the same consumption of 130·2 grains, show the difference in the illuminating power of the gas to be 2·42 candles; the former representing it as 13·02, and the latter as 15·44 candles, by the readings of the photometer. These are examples of candles burning the same quantity of sperm, yet giving a different amount of light. The greatest difference in the illuminating power of the "standard gas" shown throughout the 44 experiments made upon this day was 4·60 candles; being between experiment No. 51, with a consumption of 129 grains, giving an illuminating power of 13·58 candles, and experiment No. 60, consuming 134·7 grains, representing the gas to be 18·18 candles.

An examination of the various diagrams demonstrates that the differences in the candles may be classed under five heads, viz.:—1. Differences in the illuminating power of parliamentary standard candles, burning at the rate of 120 grains per hour. 2. Differences in the illuminating power of normal standard candles, burning at the rate of 135 grains per hour. 3. Candles with different rates of consumption giving the same amount of light. 4. Candles with the same rates of consumption giving a different amount of light. 5. Greatest differences of illuminating power in the whole number of experiments when corrected to the parliamentary standard.

From the following tabulated results of three other sets of experiments belonging to this series, it appears that in one (diagram No. 4), where the consumption of sperm varies from 109·2 grains to 134·4 grains, the greatest difference in the illuminating power of the gas, corrected to the parliamentary standard, is 4·59 candles. In the next (diagram No. 5), where the consumption ranges from 120·9 grains to 130·8 grains, this difference is 3·06 candles; while in the third (diagram No. 6), with a consumption of from 120 grains to 142·5 grains, the difference is 4·21 candles.

Diagram No. 4.

	Numbers of Experiment.	Consumption of Sperm by the Candles in Grains per Hour.	Difference in Illuminating Power, corrected to the Parliamentary Standard, in Number of Candles.
Difference in illuminating power of parliamentary standard candles of 120 grains per hour	..	..	—
Difference in illuminating power of normal standard candles of 135 grains per hour	81 & 80	134·1 & 134·4	2·28
Candles giving same amount of light, but consuming different quantities of material	83 & 85	109·2 & 140·1	3·53
Candles consuming same quantity of material, but giving different amounts of light	81 & 80	134·1 & 134·4	2·28
Greatest difference in illuminating power of gas, corrected to the parliamentary standard, shown in the whole number of experiments	83 & 80	109·2 & 134·4	4·59

Diagram No. 5.

Difference in illuminating power of parliamentary standard candles of 120 grains per hour	..	..	—
Difference in illuminating power of normal standard candles of 135 grains per hour	..	..	—
Candles giving same amount of light, but consuming different quantities of material	1 & 5	120·9 & 144	2·57
Candles consuming same quantity of material, but giving different amounts of light	2 & 4	136·2 & 136·2	·63
Greatest difference in illuminating power of gas, corrected to the parliamentary standard, shown in the whole number of experiments	1 & 5	120·9 & 130·8	3·06

Diagram No. 6.

Difference in illuminating power of parliamentary standard candles of 120 grains per hour	6 & 6	120· & 120·3	·43
Difference in illuminating power of normal standard candles of 135 grains per hour	..	..	—
Candles giving same amount of light, but consuming different quantities of material	6 & 9	120· & 146·1	2·83
Candles consuming same quantity of material, but giving different amounts of light	8 & 7	142·5 & 142·5	2·30
Greatest difference in illuminating power of gas, corrected to the parliamentary standard, shown in the whole number of experiments	6 & 7	120· & 142·5	4·21

As the Institute of Civil Engineers have considered these investigations of sufficient importance to induce them to make a special publication of them for the use of their members, which is probably in the hands of most of you, it will be unnecessary for us to detain you further in respect of them. We beg only to remark that the unsuitableness of a sperm candle for the purposes of a standard is so conclusively shown that it remains with the gas referees to justify its continued adoption.

The difficulty is the selection of such a standard. As the French system of photometry has been very well spoken of at different times by those who are qualified to form an opinion on this subject, it will be now the proper time to explain to you shortly what it is.

First, then, the standard of comparison is colza oil, refined in a peculiar manner, and carefully verified by proper persons appointed by the municipality of Paris for the purpose. The process cannot be given here for want of time, but I may mention that the same oil is used for all the Government lighthouses in France, and is also tested chemically and otherwise by the officers belonging to this department. Up to the present time they have without doubt managed to keep the oil practically to the original standard, as arranged by Dumas and Regnault about 12 years ago.

It is consumed in a carcel or moderator lamp. This is the kind of lamp fitted with proper glasses, both lamp and glasses made to a specified pattern.

The kind of photometer used is that called Foucault's photometer, which is a modification of the original Count Rumford's photometer, a diagram of which is here.

It will be seen, by reference to the coloured diagram of the French photometer, that the two lights to be compared—the gas and the lamp—are placed side by side.

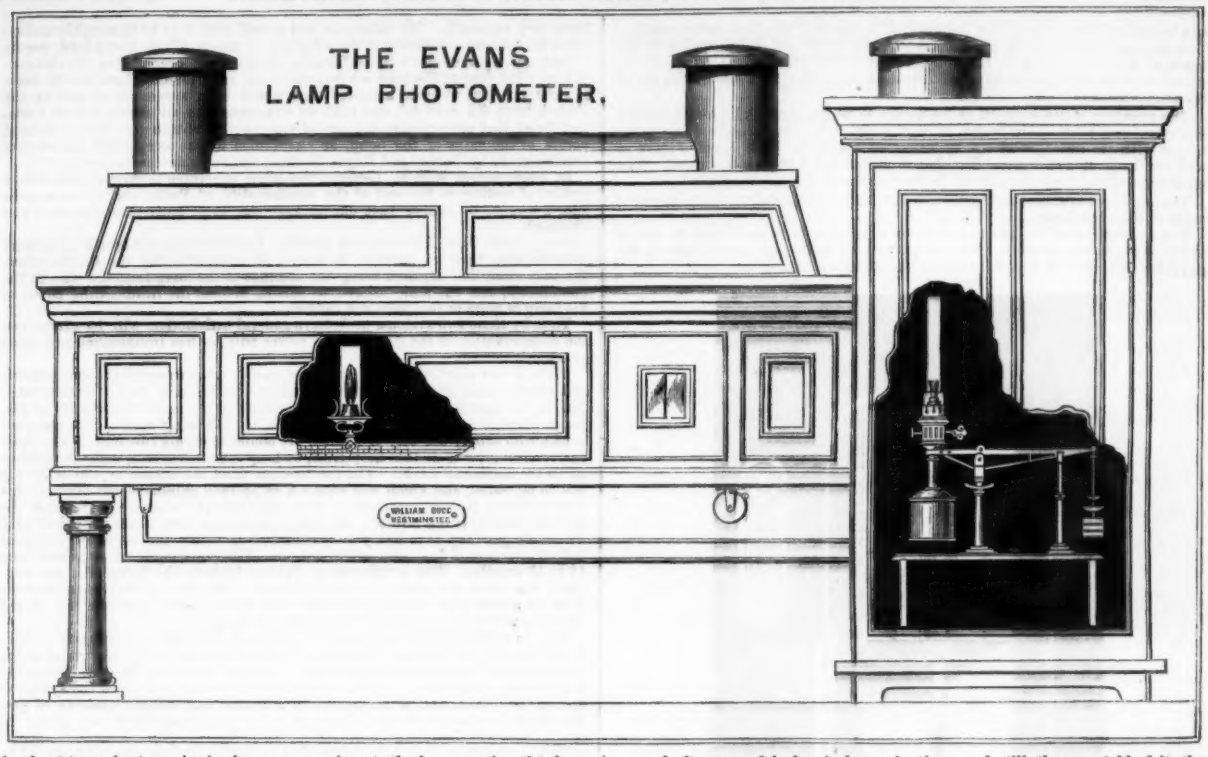
The rays from each light fall upon a disc of glass prepared with ground rice so as to be rendered opalescent.

Now, as to whether the lamp burning colza oil is more reliable than the standard candle, we unhesitatingly answer in the affirmative. In the first place it is readily adjusted, and the required consumption of oil can be obtained, even by inexperienced operators, in a very short time. A moderately experienced operator will get it within a few grains every time. Once adjusted it will burn without any very sensible alteration for two or three hours together.

To show you how reliable it is as a standard, we shall refer you to the diagrams marked "Theory of Jet Photometer and Duration Test."

On the first—on the diagram, "Retrogade Scale"—you will see a number of red stars. Each of these red stars represents three experiments performed at the French photometer in a very ordinary manner. Understand clearly that no extra care was taken to make the lamp burn well—not so much as would be taken by an ordinary operator—yet you will see that the regularity of the red stars is much greater than that of the black quatrefoil, which represents the average of twelve experiments with sperm candles, each quatrefoil.

The widest lamp experiment is 1½ candle out; the widest candle experiment is 1·8 candle out. The difference is not great between the two in appearance, but when you consider that the quatrefoil represents twelve experiments, while the red star represents only three, it will necessarily follow that had the same number of experiments been performed with the lamp as with the candles, they would all have been much closer to the truth. More than this, in these experiments several variations were made in the management of the lamp—for instance, in some experiments it was allowed to burn for ten minutes before commencing the first experiment; in others it was lighted, and the experiment commenced



in about two minutes. Again, in some experiments the lamp continued to burn untrimmed from the first to the last; in others it was trimmed every time. So that you will see no favour was shown to the lamp at all. The candles, on the other hand, were doing their best in the hands of trained operators.

Shortly, then, if the lamp is properly trimmed and allowed to burn, as defined by the French authorities, half an hour before being used for experiments, we think that, as a standard, it will be far before the candles in reliability and ease of manipulation. You will have no trouble with the standard burning more or less than it ought. The exact quantity required may be readily fixed, and a very slight alteration only will take place after it has been burning for an hour or two.

Probably it will be objected that it is impossible to make use of a French model carcel or moderator lamp for English testing, because the method of gas examination as arranged by Dumas and Regnault is so totally different to ours, that the public would not understand at all what is meant by a 22-litre gas or a 20-litre gas. Permit us to set your minds perfectly at rest on this score; we do not propose to ask the public to do anything of the sort.

The new Evans's lamp photometer, which is here, settles that difficulty at once. The operator reads off the scale in true standard sperm candles, the same as with any other instrument provided with candles as a comparison. No calculation is necessary on the part of the operator to convert the terms of the lamp into those of the true sperm candle. A short description of the instrument will prove this to you.

Like the ordinary Evans's photometer this requires no dark room, both the standard light and that for the gas to be examined are enclosed so as not to be affected by extraneous light, although they are not at all closed to the admission of an abundent supply of air without draughts.

The disc, which is fixed, is not, in the one before you, in the middle of the photometer scale, but nearer to the lamp. The scale on the left side of the disc goes from 1 at the disc to 30 on the left of the disc. The value of a lamp of the Paris model burning the same kind of oil as that used by the municipality of Paris, at the rate of 648 grains per hour, is, we have found, 9·6 candles; that is average well-made sperm candles such as are used for gas-testing purposes all over the country. Therefore the lamp is placed at that distance from the disc which is equal to the distance marked on the scale for 9·6 candles, whatever that may be. No calculation, therefore, is required.

The gas, which is made to move by means of a simple action worked by a pinion of 10 into a wheel of 100 in a smooth steady manner, is brought by the operator into that position in which it illuminates the left side of the disc to the same extent as does the lamp that on the right. The figure on the scale at which the pointer stops represents candles—thus, suppose the pointer is found at 14, then the gas is equal to 14 sperm candles, supposing the lamp to have burned at the rate of 648 grains per hour.

Diagram No. 10 shows by inspection the correction required to be made for any variation in the consumption of oil by the lamp. The balance upon which the lamp hangs is one designed by Mr. Keates, one of the gas examiners for the Metropolitan Board of Works, a gentleman who has had great experience in the testing of gas and oil. You will observe it is much lighter than that devised by my illustrious *confrère* Adrien Deleuil of Paris, a name well known in the scientific world of that capital.

It will turn readily to half a grain when loaded; Deleuil's turns to three-quarters under the same circumstances. A simple spot of mercury at the tail of the beam on the supporting crutch is made to complete the circuit of a current of electricity when the quantity of oil required is consumed, and either to stop the clock, or by the ringing of a bell to call the operator's attention to that fact. This method of ascertaining when the lamp had burned its proper quantity was adopted in the construction of the "cross" photometer, and used in all our experiments, and was found to be very effective.

Mr. Mann, of the City of London Gas-Works, has kindly lent us a clock which he has arranged so that it can be stopped and started by electricity, or by the hand, at the option of the operator.

The regulation and measurement of the gas is effected in the ordinary way by means of a clock-meter, governor, and micrometer adjustment.

The *modus operandi* of the experiment is similar to that described in the gas referees instructions—viz., ten minutes observations—the only difference being that 108 grains of oil are consumed instead of 40 grains of sperm candle.

What, then, is the outcome of all these experiments, and how do they apply to the general every-day business of the supply of gas? This is what we shall now proceed to show. First, then, the great desideratum for the gas manager is an uniform quality of gas. Irregularities in the purity of gas are only discovered after a careful chemical examination; and, till they are told of it, the majority of consumers are, unless in very bad cases, totally unaware of the presence of impurities in the gas they are burning. Such is not the case with regard to illuminating power. Any falling off in that respect manifests itself at once to every consumer. The eye is a very good photometer, and persons who have been accustomed to read or work by the same light every night readily detect a difference. Nor does it necessarily follow that in all such cases the gas is, as consumers say, bad or defective in illuminating power. Not at all; the difference may be in this, that the gas complained of may be quite up to the standard, or even beyond it, but from some cause or other it is not quite so good as that which may have been supplied on previous nights, which was, perhaps, considerably above the standard. Therefore we maintain that it is quite as injurious to the consumer to supply him with gas of a higher quality than the standard or normal gas which he is prepared to consume, and for which his burners may be arranged, as it is to take the contrary course. The desideratum is uniformity of quality, which is to be obtained, without any large amount of trouble, by all.

Our own experience, and that of many other engineers who have had ample opportunities of practically testing their qualities, leads us to this conclusion, that a good Lowe's jet photometer on the gas after it is purified, and before going into the holders, will, if its indications are attended to, ensure something very like uniformity in the quality of the gas made. Some have said that it can be done, on large establishments, to as near a point as half a candle. Be this as it may, we see ourselves no reason to doubt this assertion.

There should also be another on the gas which issues to the public. Any variation in the illuminating value of the gas is thus easily detected without any scientific experiment, or anything more than a glance at the flame of the jet. Under ordinary circumstances, so long as the manager himself is on the works to make experiments or judge of the gas which is being made by the look of the flame which he always keeps burning for the purpose, all will go on rightly; but if he be called away or is gone to bed—for even gas managers must eventually go to bed, at least the married ones—an unlooked-for variation in the quality of the coal or other causes may be the means of producing inferior gas, which is only discovered by the manager long after it has gone into the gasholders.

But on the system proposed by us let us suppose, for instance, it is required to supply gas equal to 14 candles at the testing-station. It is usual in such cases to make the gas so that at the works it is about 2 candles above the standard. The diagram for the jet photometer shows that 16-candle gas will maintain a flame of 7 inches on one of the instruments adjusted to this system, at a pressure of ·575—*i.e.*, 57½-100ths of an inch; therefore the manager simply puts such weights upon the second of the two governors attached to the photometer as will maintain that pressure. His instructions to his subordinates are then to keep the flame at 7 inches, using cannel if requisite. Their careful attention to the jet obviates all collision with the authorities or the consumers, and the gas manager is saved the crowd of blessings, or their opposites, invoked upon his head whenever the quality of the gas is from any cause changed from its normal value.

As a check upon the general working of the jet photometer, the registering duration test here exhibited will be found most valuable, and easy of practical application.

When this instrument is made use of, the flame of the jet must be under all circumstances kept to 7 inches; if above, the pressure must be lowered, and if below that height, raised. Therefore it is evident the manager must set his governor to give such a pressure as will be required by the lowest quality gas he may happen to make.* Thus worked, at the end of twelve hours the card-dial will have registered upon it the illuminating power of the gas from hour to hour—one card for the day and one for the night. But all self-photometers must be occasionally examined by the aid of a comparison photometer. Various causes produce derangements in them, which, though they may be slight, or otherwise, are not discoverable except by now and again comparing them with some accepted standard of comparison. Of course, an occasional comparative experiment for the purpose of verifying instruments is a very different thing to the continual estimation of the illuminating power by such proper instruments, and more time and care may be devoted to such a purpose than could possibly be spared out of the ordinary course of the duties of a gas manager.

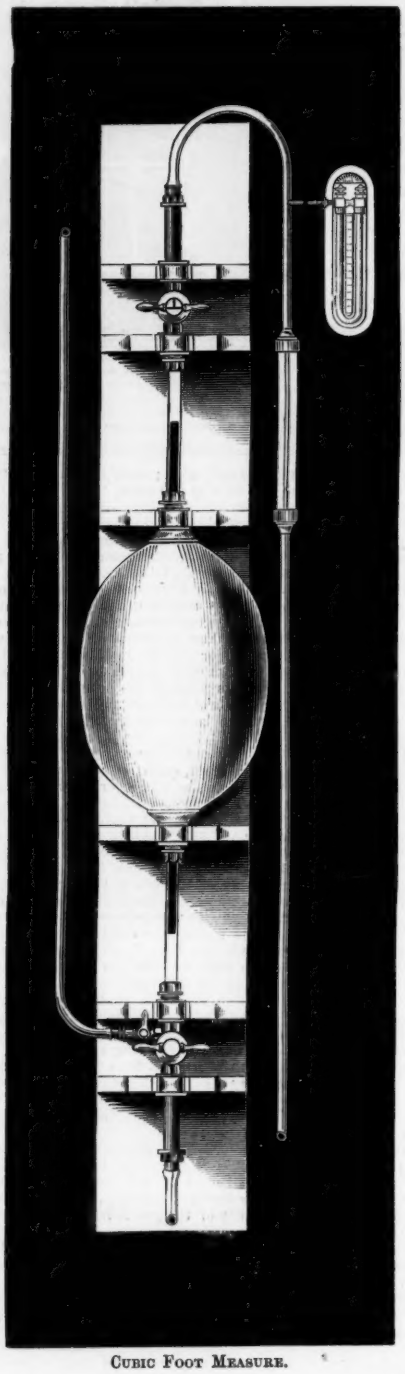
As well for this purpose as for the verification of the gas by the public examiners, the standard we propose for adoption is a moderator lamp and balance, similar to the one here exhibited, burning colza oil similar in quality to that made use of by the municipality of Paris, at the rate of 648 grains per hour, fitted to a photometer arranged in such a manner that the illuminating power

can be read off the scale of the instrument in average standard sperm candles. This average is given on the chart of the jet photometer, and is 9·6 candles for the value of the light given by the lamp, at 648 grains per hour. Corrections for variations from the true standard of consumption of oil to be made by the use of the curve marked on diagram 10.

The quantity of gas supplied to the burner to be registered by a meter similar to the one exhibited. The meter to be provided with a minute-clock in combination with its index, working by means of a weight. This clock to serve as well for the lamp as the gas. No other clock to be used in the experiment. The regulation of the gas to be effected in the manner as at present adopted.

The lamp once trimmed and lighted, to burn half an hour before the commencement of the experiment.

The verification of the measurement of the meter to be performed by means of the cubic foot measure, in the manner pointed out in the instructions of the gas referees appointed under the City of London Gas Act.



Cubic Foot Measure.

The verification of the oil to be carried out in sufficient bulk by the aid of the "cross" photometer, fitted with two sets of lamps and two sets of candles.

The gas pillar in the centre of the photometer to be supplied with a constant quantity of ordinary gas—as example, of not more than 14 candles illuminating power consumed; a standard Argand burner, capable of perfectly consuming the gas, and maintaining a steady flame.

The candles to be those made by two or more first-class makers, and such as they declare to be genuine sperm candles.

A sufficient number of experiments to be made to justify the acceptation of the grand average as correct.

This expression of opinion is in sum similar to that expressed by Mr. Kirkham in his paper read at the Institute of Civil Engineers.

There is upon the table a moderator lamp fitted to burn sperm oil, constructed according to designs furnished by Mr. Keates, already mentioned, whose experience in the matter of oil testing is, perhaps, second to none. This gentleman, it is fair to say, advocates the adoption of sperm oil, and his lamp is said to burn very regularly. My colleague and myself wish it to be thoroughly understood that we do not condemn the adoption of sperm oil as a standard, nor do we set our opinion as to the reliability of colza oil over that of Mr. Keates. We only say that at the time we performed our experiments there was no lamp in existence that we were aware of that would burn sperm oil so well as the French lamp did colza oil, and that we examined the oil obtained from Paris, and found that our experiments agreed very nearly, within one or two decimal points, of the value of the lamp, as ascertained by the comparison with sperm candles made by Dumas and Regnault about ten or twelve years ago.

In conversation with M. Leblanc, the officer appointed to carry out the whole system of testing on the part of the municipality of Paris, about two months ago, I was led to believe that our average was even truer than that they had obtained.

At the same time, if it is proved that Mr. Keates's lamp and sperm oil is more reliable than that we propose, it is easy to substitute the one for the other, the only alteration required being the distance of the lamp from the disc in the photometer, and the scale altered to suit it, in case the illuminating power of his lamp is more or less than 9·6 candles.

Thus by these two systems we believe general satisfaction will be given, and the determination of the illuminating power will be less troublesome and more exact.

There is one point which now arises frequently in photometrical examinations, and which causes much trouble, although we believe it is easy of settlement—that is, the question of the proper consumption of the specified quantity of gas. As an illustration of this difficulty, we cite the following case:—The gas companies who supply the City of London are bound to supply 16-candle gas to their customers. Now to do this they must, to keep themselves safe, make the quality up to 18 candles as a rule. The gas referees fixed the burner by which the gas was to be tested, and which was with a 6 by 1¼-inch chimney—the same as this one—suitable for the combustion of 5 cubic feet of 14-candle gas; but as the standard candle is not reliable, the companies found that if they supplied only 16-candle gas they were likely to be returned as below the standard, and were indeed so returned from one or two stations. The gas was, therefore, raised from 16 to 18 candles. The result was no better; in fact, the better the gas supplied, the worse the return of the examiners. The cause of this unsatisfactory state of affairs was very simply this—the flame tailed over the top of the chimney when the gas was burning 5 feet per hour.

It is an axiom that the gas must be consumed. The reason why it is so is this: Although, for the purposes of testing, Parliament wisely fixes the rate at which the gas to be tested is to be consumed, so that all gases may be examined under the same circumstances; yet the consumer, for whose protection the system of testing is established, is not bound to consume any definite quantity of gas. He wants a certain amount of light, and the price being fixed, the better the gas he is supplied with by the company, the cheaper he gets his required amount of light; therefore, it is bare justice that in testing the gas none of it should be allowed to tail over the glass of the testing-burner, and so diminish the photometrical result.

The remedy is simply this: If the 6-inch chimney will not promote the perfect combustion of the richer gas, put on a 7-inch; and if that will not do it, put on an 8-inch. Increasing the length of the chimney with the standard testing-burner augments the quantity of air supplied to the flame. In all cases that chimney which is sufficient for the proper combustion of the gas only must be used.

As this lecture has already exceeded the limits which we had prescribed for ourselves, many important subjects which we should have liked to have brought under your notice are necessarily omitted. We have, however, given you the salient points connected with our subject, which must be discursive, owing to the want of a definite basis of operations from which to start, and the most perfect of all experiments being but approximations to the truth. It may happen that at some future time, let us hope not far distant, the practice of photometry may be reduced to a mathematical certainty, but till that halcyon day arrives, we must be content to go as carefully as we can, and get as near the truth as possible.

We cannot conclude without expressing our obligations to Mr. Keates for the loan of lamps and balance; to Mr. J. O. N. Rutter, of Brighton, who kindly lent for exhibition a Dr. Fox's shadow photometer and a Ritchie sighting-box, which, being before you, we have thought it unnecessary to explain in detail; and to Messrs. Fred. and Arthur M'Minn, of Fulham, as well as to several members of my own staff, for their kind assistance; and if our remarks should have for result increased appreciation of the value of photometry as at present applied, or in the production of some marked improvements in its practice, both we ourselves and those who identify themselves with us will feel amply compensated for any trouble we have taken.

A cordial and unanimous vote of thanks was given to the lecturers.

Colombo Gas and Water Works.—The directors of the Colombo Gas and Water Company, Limited, have issued a circular stating that they have made a very favourable arrangement with Mr. George Bower, of St. Neots, for the construction of the works.

Average Composition and Quality of the Metropolitan Waters, June, 1870.—The following are the returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total Solid Matter per Gallon.	Oxygen required by Organic Matter, &c.	Nitrogen.		Hardness.	
			As Nitrates, &c.	As Ammonia.	Before Boiling.	After Boiling.
Thames Water Comps.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Grand Junction	17·00	0·079	0·023	0·001	13·0	3·5
West Middlesex	17·40	0·034	0·020	0·001	13·6	3·6
Southwark and Vauxhall	17·98	0·066	0·023	0·005	13·7	4·1
Chelsea	18·07	0·086	0·023	0·002	13·9	3·8
Lambeth	18·57	0·069	0·027	0·001	13·9	4·2
Other Companies.						
Kent	26·77	0·004	0·033	0·000	19·2	5·2
New River	16·03	0·021	0·023	0·000	12·6	3·4
East London	15·83	0·034	0·027	0·001	11·8	3·2

Note.—The amount of oxygen required to oxidize the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and, in the case of the metropolitan waters, the quantity of organic matter is about eight times the amount of oxygen required by it.

The water was found to be clear and nearly colourless in all cases. The average quantity of water supplied daily to the metropolis during the preceding month was, according to the returns of the water companies to the Association of Medical Officers of Health, 107,279,754 gallons; and the number of houses supplied was 478,255. This is at the rate of 33·3 gallons per head of the population daily. The last official return from Paris stated that the average daily supply per head of the population was 23 gallons; but this includes the water used for the public fountains, and for the ornamental waters in the Bois de Vincennes and the Bois de Boulogne.

Hy. Letheby, M.B.

DIMINUTION OF SUNDAY LABOUR AT THE BATH GAS-WORKS.—Some time since the Rev. Prebendary Kemble, as the representative of a society that is in existence in the metropolis for the purpose of diminishing, as far as possible, Sabbath labour in gas-works throughout the United Kingdom, had an interview with Mr. Gill, the chairman of the Bath Company, in order to lay before him the views of the society, and endeavour to get them adopted as far as practicable. This having been done, Mr. Gill promised to do all in his power to relieve the men from work on Sunday, and the matter was referred to Mr. Anderson, the company's superintendent, who has always been favourable to the diminishing of Sunday labour, and who, when he came to the Bath Gas-Works seven years ago, arranged a scheme by which several of the men were liberated on Sundays; but the state of the business of the company at that time would not allow of its continuance. This gentleman has now brought the work of the company to such an efficient state that what was before impossible is now found to act well. He has arranged a scheme by which two-thirds of the men will be allowed to leave on each Sunday. The privilege will, of course, be equally distributed among the men, and each man will receive his pay as if he were at work. We are pleased to see this endeavour on the part of the Bath Gas Company to mitigate, as far as possible, the labour of their workmen, which is not of the most agreeable character.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

1733.—CHARLES JOSEPH, of Grosvenor House, South Place, Kennington Park, in the co. of Surrey, for "*Improvements in gas-burners.*" A communication. (Complete specification.) June 17, 1870.

1768.—THOMAS COMMON BROWN, of Ipswich, in the co. of Suffolk, engineer, for "*Improvements in valves applicable to steam or water pressure.*" June 21, 1870.

1792.—EDWARD FINCH, of Beaufort Square, Chepstow, in the co. of Monmouth, for "*Improvements in machinery for forcing or exhausting air or aëriform fluids.*" June 23, 1870.

1793.—WILLIAM ROBERT LAKE, of Southampton Buildings, London, consulting engineer, for "*An improved faucet.*" A communication. June 23, 1870.

1797.—PETER JENSEN, of 89, Chancery Lane, in the co. of Middlesex, consulting engineer and patent agent, for "*Improvements in apparatus for indicating the speed of vessels and the velocity of running water.*" A communication. June 24, 1870.

1799.—ANDREW STEWART and JAMES STEWART, of Glasgow and Coatbridge, both in the co. of Lanark, N.B., tube manufacturers, for "*Improvements in the manufacture of welded iron and steel tubes, and in apparatus therefor.*" June 24, 1870.

1815.—DAVID ROWAN, of the city of Glasgow, in the co. of Lanark, N.B., engineer, for "*New or improved constructions and arrangements of valves and their actuating parts, and their application to steam boilers and engines, suitable also for other purposes.*" June 27, 1870.

1849.—SAMUEL NORTON, of the firm of Norton and Co., of Stockport, in the co. of Chester, patentees manufacturers, for "*An improved and combined hydraulic filter and double valve-tap.*" June 29, 1870.

GRANTS OF PROVISIONAL PROTECTION.

1679.—ROBERT THOMAS YEADON JOHNSON, of Stockton-on-Tees, engineer, for "*Improvements in rotary engines and pumps.*" June 10, 1870.

1682.—BRISTOW HUNT, of 1, Serle Street, Lincoln's Inn, in the co. of Middlesex, gentleman, for "*An improved joint for water, gas, and steam pipes.*" A communication. June 11, 1870.

1706.—BEVAN GEORGE SLOPER, of Northfleet, in the co. of Kent, for "*Improvements in the treatment of sewage.*" June 14, 1870.

1707.—GEORGE WEIR, of Glasgow, in the co. of Lanark, and JAMES WEIR, of Liverpool, in the co. of Lancaster, for "*Improvements in slide-valves.*" June 14, 1870.

INVENTION PROTECTED FOR SIX MONTHS ON THE DEPOSIT OF A COMPLETE SPECIFICATION.

1733.—CHARLES JOSEPH, of Grosvenor House, South Place, Kennington Park, in the co. of Surrey, for "*Improvements in gas-burners.*" A communication. June 17, 1870.

NOTICES TO PROCEED.

398.—WILLIAM M'GEORGE MASON and THOMAS LOCKERBIE, both of Glasgow, in the co. of Lanark, N.B., for "*Improvements in utilizing water pressure in raising liquids, and in apparatus therefor, also in pressure-reducing valves for the said apparatus, and applicable otherwise.*" Feb. 10, 1870.

424.—ALEXANDER PRINCE, of 4, Trafalgar Square, in the co. of Middlesex, for "*Improvements in generating gas from petroleum and other oleaginous substances, and in the apparatus to be employed therein.*" A communication. Feb.1 2, 1870.

463.—SIGISMUND LEONI, of 34, St. Paul's Street, New North Road, in the co. of Middlesex, manufacturer, for "*Improvements in apparatus for cooking, heating, and lighting by gas.*" Feb. 17, 1870.

504.—WILLIAM EDWIN HEATH, of 23, Camden Road, in the co. of Middlesex, gas engineer, for "*Improvements in gas pressure-governors.*" Feb. 21, 1870.

506.—JOHN LEOPARD, of Hassocks Station, Hurstpierpoint, in the co. of Sussex, for "*Improvements in treating and filtering sewage, and in apparatus to be employed for these purposes.*" Feb. 21, 1870.

577.—JOHN RANDALL MANN, of East Cowes, in the Isle of Wight, for "*Improvements in and connected with water-closets and other sanitary appliances.*" Feb. 26, 1870.

706.—CHARLES ASTON WINDER, of Sheffield, in the co. of York, engineer, for "*An improved apparatus for use in drawing and forcing air, water, and other fluids.*" March 10, 1870.

1311.—ROBERT WEARE, of Newcastle-under-Lyme, in the co. of Stafford, sanitary contractor, for "*Improvements in apparatus for receiving and treating sewage and other noxious matters.*" May 7, 1870.

1467.—ALBERT MARCIUS SILBER, of Wood Street, Cheapside, in the City of London, merchant, and FREDERICK WHITE, of Camberwell, in the co. of Surrey, watchmaker, for "*Improvements in apparatus for lighting and heating purposes.*" May 20, 1870.

1514.—GEORGE THOMAS, of Colchester, in the co. of Essex, bank manager, for "*Improvements in the construction of gas-stoves.*" May 25, 1870.

1707.—GEORGE WEIR, of Glasgow, in the co. of Lanark, and JAMES WEIR, of Liverpool, in the co. of Lancaster, for "*Improvements in slide-valves.*" June 14, 1870.

1733.—CHARLES JOSEPH, of Grosvenor House, South Place, Kennington Park, in the co. of Surrey, for "*Improvements in gas-burners.*" A communication. June 17, 1870.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

1819.—GEORGE DICKIE, "*Improvements in the manufacture of illuminating gas.*" June 21, 1867.

1821.—FRANCIS REDDICLIFF, "*Improvements in buckets for pumps, especially suitable for pumps for mines, and in pistons for steam and other engines.*" June 21, 1867.

1822.—EMORY M'CLINTOCK, "*Improvements in the construction of motive-power engines and pumps.*" June 21, 1867.

1827.—STEPHEN HOLMAN, "*Improvements in double-action pumps, and in the methods of operating pumps, part of which improvements are applicable to other reciprocating machines.*" June 22, 1867.

1828.—THOMAS WILSON and WILLIAM HALL, "*Improvements in machinery or apparatus for raising and forcing water and other fluids.*" June 22, 1867.

1834.—THOMAS RAFFERTY and JOHN HENRY STOREY, "*An improved apparatus to be employed in moving from place to place, laying down, and jointing metal pipes.*" June 24, 1867.

1837.—ELLIOTT PERRY GLEASON, "*Improvements in cylindrical or 'Argand' gas-burners.*" June 24, 1867.

1846.—THOMAS CROW, "*Improvements in the manufacture of illuminating gas from gas-tar oil or from gas tar.*" June 25, 1867.

1849.—ADAM AITCHISON and THOMAS SOUTH, "*Improvements in means or apparatus for the production of gas for illuminating and other uses from hydrocarbons, which apparatus is also adapted to be used for culinary and other heating purposes.*" June 25, 1867.

PATENT WHICH HAS BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1592.—EDWARD MYERS and WILLIAM RICHARD WILLIAMS, for "*Improvements in wet gas-meters.*" June 24, 1863.

Advertisements.

FLETCHER, SPECK, & CO.,

CONTRACTING GAS ENGINEERS, IRON & BRASS FOUNDERS'

GLENGALL IRON-WORKS, MILLWALL, LONDON, E., and RATCLIFF FOUNDRY, COMMERCIAL ROAD EAST, LONDON, E.,

MANUFACTURERS OF

TELESCOPIC and **SINGLE GASHOLDERS, TANKS, PURIFIERS, CONDENSERS,** and every description of **GAS-MAKING APPARATUS. IRON MAIN-PIPES** supplied and laid. **RETORTS, MOUTHPIECES, RETORT-LIDS, VALVES,** and **FITTINGS.** Wrought and Cast Iron Hydraulic Mains. **LAMP-POSTS, COLUMNS, GIRDERS, BRIDGES,** &c.

CORRUGATED IRON ROOFS & BUILDINGS.

GENERAL GAS CASTINGS PROMPTLY EXECUTED.

GAS AND WATER PIPES.

CLARIDGE, NORTH, & CO.,

BILSTON.

WANTED, a situation as Working MANAGER or FOREMAN of Gas-Works. Several years experience in all the branches connected with Gas-Works. Testimonials and references as to character and ability on application.

Address G., care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a young Man (24) who thoroughly understands the manufacture and distribution of gas, having served nine years on a Gas-Work, a situation as Manager, Assistant Manager, Rental Clerk, or Chief Inspector in a Gas-Work. Uses the photometer. Highest references. No objection to go abroad.

Address GAS, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SITUATION Wanted by a Man who has had 13 years experience in one of the London Gas-Works in reading meter indices, fixing, and service-laying.

Address M. R., 62, Ifield Road, West Brompton, LONDON.

THE BRITISH ASSOCIATION OF GAS MANAGERS at the Chartered Gas Company's Works, Beckton, June 9, 1870.

PHOTOGRAPHIC GROUPS of the above, well mounted for framing—size 15 inches by 12—may be had of F. R. WELLS, Photographer, Heath Street, BARKING, E. Price 3s. 6d. each.

Of the above Pictures, Magnus Ohren, Esq., President of the Association, writes: "I have examined photographs of members taken at Beckton Works, and find that there are 180 perfect likenesses."

The Hon. Sec., W. H. Bennett, Esq., also says: "Both are very excellent productions. I was much astonished to find that I could name the majority of the portraits, so accurately have they been rendered."

"The members of the British Association of Gas Managers will find an admirable souvenir of their visit to the Beckton Works in the excellent photographs of the assembled group, taken by Mr. F. R. Wells, of Heath Street, Barking."—*Journal of Gas Lighting.*

NEW CAST-IRON PIPES COATED.

A Surplus Lot to be sold cheap, 8 in., 9 in., 10 in., 12 in.

For particulars, apply by letter to O. A., care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE WREXHAM GASLIGHT COMPANY.

CONTRACT No. 3.

TO BUILDERS, CONTRACTORS, AND OTHERS.

THE Directors of the above Company are desirous of receiving TENDERS from persons willing to contract for the erection of a RETORT-HOUSE, 95 ft. by 42 ft. 6 in., and a CHIMNEY, 110 ft. high, at their new works, Wrexham.

Plans and specifications may be seen at the Office of John Rowe, Esq., C.E., College Street, Wrexham, on and after Thursday next.

Tenders to be sent to the undersigned, on or before the 20th inst., endorsed "Tender for Contract No. 3."

The Directors do not bind themselves to accept the lowest or any tender.—By order of the Board,

THOS. WALKER, Secretary.

Wrexham, July 1, 1870.

TO GAS ENGINEERS.

THE Directors of the Holywood Gas Company, Limited, will receive TENDERS for the erection, at their works, Holywood, of a TELESCOPIC GASHOLDER, 60 ft. by 40 ft., complete.

Further particulars can be had on application to the Secretary.

The tenders to be sent on or before the 11th of July next. The lowest or any tender will not necessarily be accepted.

THOS. HUNTER, Secretary.

Holywood, co. Down, June 21, 1870.

TENDERS FOR GAS COAL.

THE Directors of the Commercial Gas Company are prepared to receive TENDERS for the supply of 65,000 tons of the best GAS COAL, to be delivered into the Company's lighters in the Regent's Canal Basin, Limehouse, in as nearly as may be the following monthly quantities:—

August, 1870	8000 tons.
September, 1870	8000 ,,
October, 1870	8000 ,,
November, 1870	8000 ,,
December, 1870	8000 ,,
January, 1871	7500 ,,
February, 1871	5000 ,,
March, 1871	4000 ,,
April, 1871	3500 ,,
May, 1871	2500 ,,
June, 1871	2500 ,,

The Coal to be fresh wrought, dry, unscreened, as free as possible from pyrites, bats, bind, or other refuse, and to be weighed in accordance with the custom of the London Coal Meters Office.

Tenders to be addressed to the Secretary, endorsed "Tender for Coal," and to be delivered on or before the 21st day of July, 1870, at the Company's Offices.

The Directors do not bind themselves to accept the lowest or any tender.—By order of the Directors,

GEORGE JAQUES, Secretary.

Stepney, London, July 1, 1870.

TO GASHOLDER MAKERS.

THE Bradford-on-Avon Gas and Coke Company are open to receive TENDERS for the making and erection of a new GASHOLDER.

The dimension of the Tank they are making is 45 ft. in diameter by 20 ft. deep, to which they propose to erect a Telescopic Holder in two lifts, with five columns and girders, &c., the holder to be made of the best Staffordshire iron.

The tender to be accompanied by drawings and specifications of the form, size, and weight of the materials.

The Committee of Management do not bind themselves to accept the lowest or any tender.

Particulars may be known, and further information obtained, from the Chairman of the Company, to whom sealed tenders are to be addressed on or before the 20th day of July next.

Bradford-on-Avon, June 20, 1870.

TENDERS FOR TAR AND AMMONIACAL LIQUOR.

THE Local Board of Widnes are desirous of receiving TENDERS for their TAR and AMMONIACAL LIQUOR.

Tenders to sent to the undersigned, on or before the 9th of July, of whom also printed conditions and any other information may be obtained.—By order,

ARTHUR FIELD, Asst. Inst. C.E., Manager.

Gas-Works, Widnes.

SHIPLEY GASLIGHT COMPANY.

TO BE SOLD, the following Gas Appara- TUS—viz., One set of Four Purifiers, 9 ft. by 6 ft., with 6-in. connexions and hydraulic centre-valve complete; Two Circular Scrubbers, one 3 ft. 3 in. by 9 ft., the other 5 ft. by 10 ft., with 8-in. connexions and centre-valve complete; One Station-Meter, to pass 8000 feet per hour; One 18-in. Governor, one 8-in. do.; One 4-horse high-pressure Steam-Engine; One of Jones's Exhausters, with 10-in. connexion, valves, and by-pass; One Exhauster Governor, by Braddock (nearly new); Three Iron Roofs, 26 ft. 6 in. span by 120 ft. long (total); 45 iron D Retort Mouthpieces, 12 in. by 15 in.; 30 do. do., 18 in. by 13 in.; 45 Ascension-Pipes, 5 in. to 4 in.; 30 Ascension-Pipes, 5 in.; 45 H Pipes, 4 in. to 3 in.; 30 H Pipes, 5 in.; 45 Dip-Pipes, 3 in.; 30 Dip-Pipes, 5 in.; 7 lengths of D-shaped Cast-Iron Hydraulic Main, 6 ft. each; 6 lengths do. do., 7 ft. 3 in. each; 2 lengths of Circular do., 6 ft. 3 in. each.

Further particulars may be obtained on application to Mr. W. WRIGHT, the Manager.

Gas-Works, Shipley, May 27, 1870.

TO BE SOLD, 2 dry lime Purifiers, 8 ft. square by 3 ft. 2 in. deep. Lutings 18 in. dip.

Two Wrought-Iron Covers for same.

One Lifting Crane, one Centre-Valve, with 10-in. connexions, and can work 1, 2, or 3 Purifiers at one time.

Also Four Dry Lime Purifiers, 4 ft. square by 3 ft. deep, with riddles, lifting gear, centre-valve, with 6-in. connexions, all complete and in excellent working order.

For view, price, &c., apply to the MANAGER, Elsecar Gas-Works, BARNSLEY.

TO TAR DISTILLERS.

TENDERS for the Tar to be produced at the Gaslight Company's Works, Lewes, in the county of Sussex, during the year ending June 24, 1871, are requested to be sent to the undersigned, on or before the 8th day of July next. Estimated quantity, 25,000 gallons.

The highest or any tender will not necessarily be accepted.—By order,

WILLIAM WRIGHT, Manager.

ALFRED LASS,

ACCOUNTANT.

28, NORTH STREET, WANDSWORTH, S.W.

Mr. Alfred Lass having had considerable experience in arranging, making up, balancing and auditing gas accounts, begs to inform the Directors of Gas Companies that he may be consulted on all matters relating thereto.

Balance-sheets prepared, Accounts audited, Consultations, Agencies, &c.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET EDINBURGH.

Established 1840.

THOMAS PIGGOTT & CO.,

(Established 1822,)

SPRING HILL, BIRMINGHAM,

MANUFACTURERS OF

TELESCOPIC & SINGLE GASHOLDERS,

CAST & WROUGHT IRON TANKS FOR DITTO;

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS, VALVES;

IMPROVED WROUGHT-IRON RETORT-LIDS, CROSS-BARS, & SCREWS;

AND GAS APPARATUS OF EVERY DESCRIPTION.

CAST AND WROUGHT IRON GIRDERS, BRIDGES, AND ROOFS,

STEAM-ENGINE BOILERS, & GENERAL WROUGHT-IRON WORK.

London Agents: **PORTER and LANE, 172, FENCHURCH STREET, E.C.**

JOHN HALL & CO.,

STOURBRIDGE,

MANUFACTURERS of FIRE-BRICKS, LUMPS, & TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

1862.

PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

CLASS II.

This Paint having been in general use over eight years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

Reference is kindly permitted by the Engineers of the City of London, Commercial, London, and Surrey Consumers Gas Companies, who pronounce it the best Paint known for their purposes.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS

GEORGE NEWTON,

UNION STREET WEST, OLDHAM,

MANUFACTURER OF

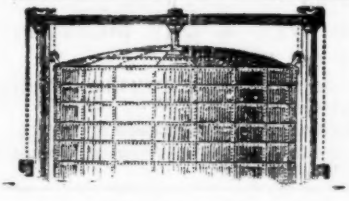
IMPROVED WET & DRY CONSUMERS GAS-METERS,

GAS STATION-METERS,

With all the Joints planed,

GOVERNORS, GAUGES, INDICATORS, EXHAUST GOVERNORS, &c.

TERMS, &c., ON APPLICATION.



IMPROVED GAS APPARATUS,

FOR CITIES, TOWNS, VILLAGES, &c.,

INVENTED AND MANUFACTURED BY

W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD.

SOLE MANUFACTURERS of B. W. THURSTON'S IMPROVED SCRUBBER, CONDENSER, and WASHER, in use in many of the principal Gas-Works on the Continent.

PATENTEES of the IMPROVED COMBINED PURIFYING APPARATUS, so eminently adapted for Exportation.

ESTIMATES, PLANS, and SPECIFICATIONS PREPARED for BUILDINGS and APPARATUS.

Prospectus, Price Lists, &c., on application.

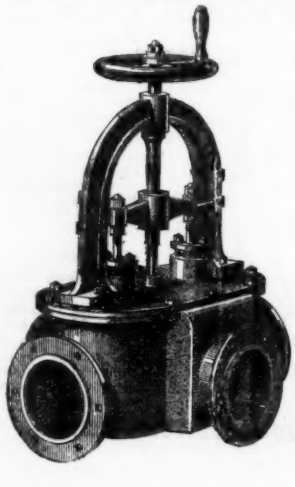
LONDON OFFICES—57, GRACECHURCH STREET, CITY.

*** *Please address letters to Huddersfield.*

REFERENCES TO NEARLY 300 GAS-WORK

CATHELS & TERRACE'S

PATENT FOUR-WAY DISC GAS-VALVE



(Being a simplification and improvement of Cathels's well-known Valve) is the best Valve for Gas-Works. It is specially applicable as a by-pass to Condenser, Exhauster, Scrubber, Station-Meter, &c., as, having no springs, ground faces, or other delicate complications to be affected by crude gas, it NEVER SETS FAST. When applied to Purifiers, the utmost facility of change is afforded; the direction of the flow of the gas is seen at a glance, and no unpurified gas can pass into the holders at each change, as happens with Centre-Valves. In either application ONE VALVE SERVES AS THREE OTHER VALVES. The opening and closing are now effected by one movement, and the ports being all on the same level, enables the connexions to be simple lines of straight piping. The closing of one gas-way opens another, preventing the possibility of accidentally stopping back the gas. The Valve has been in general use for upwards of five years, with the most satisfactory results, and is so simple and strong that it may be considered indestructible.

Illustrated Circular, Prices, &c., on application to the Makers,

Messrs. GUEST & CHRIMES,

FOUNDRY AND GENERAL BRASS-WORKS,

ROTHERHAM.

CANNEL COAL.—The West Yorkshire Iron and Coal Company, Limited, beg to draw the attention of Gas Companies to their Cannel, of which the following is the analysis made by W. Hugron, Esq., F.C.S.:

Yield of gas per ton . . . . 10,296 cubic feet.
Illuminating power rather over 21 sperm candles.
Yield of coke per ton . . . 12 cwt.

The actual working, as reported by one of the largest gas companies in Yorkshire, gives results still more favourable, viz.—

Yield of gas . . . . . 10,416 cubic feet.
Illuminating power . . . . 21·89 sperm candles.
Coke . . . . . The same.

We add from the same source the capabilities of the common gas coal—

Yield of gas . . . . . 10,080 cubic feet.
Illuminating power . . . . 14·41 sperm candles.
Yield of coke . . . . . 13 cwt.

COLLIERIES—WEST ARDSLEY, near LEEDS.

For further particulars, address to the Office of the Company, 15, York Place, LEEDS.

POPE & PEARSON'S GAS COAL.— We have now the authority of several of the most eminent Gas Engineers of London in stating that our Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles.*

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, West Riding and Silkstone Collieries, near LEEDS.

OLD WEMYSS CANNEL COAL.— Yield of gas per ton, 12,896 cubic feet; illuminating power, 31·75 standard candles. Port of shipment, Wemyss.

Analysis and price on application to Mr. WM. CAREY, Manager, Wemyss Colliery, Kirkcaldy, FIFE.

CANNEL COAL.

MESSRS. GRIFFITHS BROTHERS,
COPPA COLLIERY, MOLD,

Beg leave to call the attention of Gas Companies to the superior quality of their Cannel for gas-making purposes.

This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

Ports of shipment—Birkenhead or Connah's Quay.

Waggons supplied for delivery by railway to any part of England or Wales.

For particulars, prices, and rates of freight, apply to GRIFFITHS BROTHERS, Coppa Colliery, Mold, FLINTSHIRE.

THE
HUCKNALL COLLIERY COMPANY
Can offer a CANNEL COAL yielding a large quantity of Gas of superior quality.

Prices and information on application to the HUCKNALL COLLIERY COMPANY, Hucknall Torkard Collieries, near NOTTINGHAM.

THOMAS EDINGTON & SONS,
PHŒNIX IRON-WORKS,
GLASGOW,
Manufacturers of all kinds of
GAS AND WATER PIPES,
Branches, Bends, Water-Traps, Tank-Plates, Valves, and general Castings. Also
RAILWAY CHAIRS & SLEEPERS,
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Engineers,
ARDWICK IRON-WORKS,
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MANUFACTURERS OF
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PIPES, VALVES, IRON ROOFS,
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DESIGNS, SPECIFICATIONS, & ESTIMATES FURNISHED.

FIRE-CLAY GAS-RETORTS, &c., CANNEL AND STEAM COALS.

WILLIAM FRASER, Inverkeithing (owner of the Works at which Fire-Clay Retorts were first made), having greatly enlarged his Works, can supply RETORTS and other FIRE-CLAY GOODS to any extent.

References can be given to managers of above a hundred Gas-Works whom he supplies.

WILLIAM FRASER ships COWDENBEATH PARROT COALS at Charlestown and Burntisland at 11s. per ton; and HALBEATH STEAM COALS, on Navy List, at 7s. per ton.

INTERNATIONAL EXHIBITION, 1862.
CLASS X.
PRIZE MEDAL
For excellence of Fire-Clay Gas Retorts, and
"HONOURABLE MENTION" for
good quality of Fire-Bricks.
WILLIAM STEPHENSON & SONS,
THROCKLEY,
NEWCASTLE-ON-TYNE.

J. T. B. PORTER & CO.,
GAS ENGINEERS,
MANUFACTURERS AND CONTRACTORS FOR GAS-WORKS
Of any extent at Home and Abroad,
GOWTS BRIDGE WORKS, LINCOLN,
AND
JOHN STREET, ADELPHI, LONDON, W.C.

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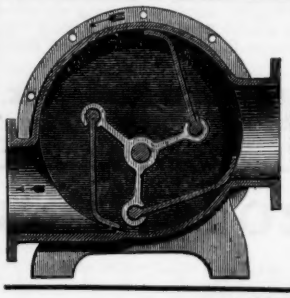
MANUFACTURER OF
WET & DRY GAS-METERS, STATION-METERS, GOVERNORS, &c.
SOLE MANUFACTURER OF
PADDON'S PATENT STREET-LAMP REGULATORS,
For ensuring any required consumption. These Regulators are in general and increasing use, and references can be given to Gas Companies who use them for every Lamp.



CHARLES HORSLEY'S
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GAS EXHAUSTER.
(From 250 Feet upwards per Hour.)
Also,
ROTARY TAR AND OIL PUMPS.
For particulars and prices apply to the Patentee,
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R. D. recommends his Fire-Brick Retorts to Engineers and Managers of Gas Companies; they last from 10 to 12 years.

Iron and Fire-Clay Retorts.
Annular and Pipe Condensers.
Scrubbers and Purifiers, all sizes.
Steam-Engines and Exhausters.
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Gas Castings of every description.
Retort Setters and Fitters sent to all parts of the country.
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MANUFACTURERS OF IMPROVED WET & DRY METERS;
Also, EVERY DESCRIPTION OF GAS APPARATUS,
Comprising GASHOLDERS, STATION-METERS, GOVERNORS, CONDENSERS, PURIFIERS, RETORTS, SLIDE-VALVES, and every article appertaining to Gas-Works.
Gas Companies advised on Improvements, Extensions, and Alteration of Works.
*** The very best material and workmanship guaranteed, and at prices bearing a favourable comparison with any House in the Kingdom.

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MANUFACTURERS OF GASHOLDERS, TANKS, PURIFIERS,
AND ALL DESCRIPTIONS OF GAS-MAKING APPARATUS.
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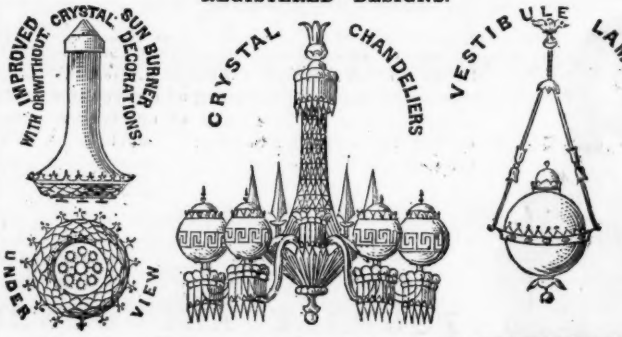
LIGHTS, AND THE PATENT CRYSTAL ILLUMINATION;
Vestibules, Iron Barrel, Composition Tubing, Dry & Wet Meters, & Gas-Fittings
OF EVERY DESCRIPTION.
WORKS: LONDON, BIRMINGHAM, & PARIS.
REGISTERED DESIGNS.



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The Patent Gas-Regulator and Purifier reduced to 6s. 6d. per Doz.

Pattern-Books of Gas-Fittings, Crystal and Ormolu Chandeliers for 1870, are now complete.

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REDUCED PRICES
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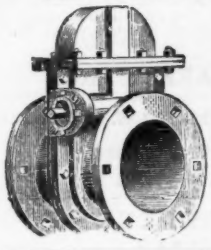
IMPROVED GAS-VALVES
WITH WROUGHT-IRON PINIONS,

From 2 inches to 18 inches, price 9s. 6d. to 12s. per inch diameter.



List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.

These Valves are all proved on both sides to 30 lbs. on the square inch before leaving the works, and are always kept in stock.

VALVES MADE WITH OUTSIDE RACKS TO ORDER.
ALSO,
SCREW WATER-VALVES WITH GUN-METAL FACES.

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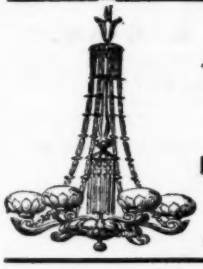
GAS AND CONSULTING ENGINEER,
COLCHESTER, ESSEX,
INVENTOR & PATENTEE of CAST-IRON & FIRE-CLAY RIBBED RETORTS.

Mr. Fraser having had more than Twenty years experience in the Construction, Alteration, and Management of GAS and WATER WORKS, will be happy to furnish information on all matters appertaining thereto.

Plans, Specifications, and Estimates prepared.



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BROAD STREET, BIRMINGHAM.
ESTABLISHED 1807.
MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS,
WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.
TABLE GLASS OF ALL KINDS.
CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.

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Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,
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Station-Meters, Governors, Consumers Meters, Gas Lustres, Chandeliers, Brackets, &c., and every description of Gas-Fittings and Gas Apparatus.

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MR. ANDERSON advises Companies on all matters connected with the manufacture of Gas and the construction of Works.

PATENTEE and MANUFACTURER of the following Inventions:—
RETORT SETTINGS, heated by tar without the production of smoke.
STEAM-ENGINES and EXHAUSTERS, separately or combined.
FOUR-WAY VALVES, one of which is equal to three ordinary Valves.
STATION GOVERNORS—the Gasholder cannot tilt and cause accident.
BREEZE AND TAR FUEL MACHINE.

A Pamphlet containing Eighteen Illustrations of the foregoing, with letterpress on the construction of Works, post free, 2s. 6d.

N.B.—The second edition of this Work, *now ready*, contains illustrations of the Machine for converting Breeze and Tar into Fuel for heating the Retorts.

"The Author is well qualified to speak authoritatively upon the important subjects to which his pamphlet refers."—*Artizan.*

SCHOLL'S
PATENT PLATINUM
GASLIGHT PERFECTER.

Extract from Report by Dr. Letheby:—

"The results have been very remarkable, for they show an average increase of 63 per cent. on the illuminating power of the gas. I am of opinion, therefore, that the invention is of great practical value."

Price 1s. each for Fishtail Burners.

To be had retail of Gas-Fitters and Ironmongers, and wholesale of
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Terms on application. N.B.—A specimen sent free on receipt of Twelve stamps.

*** Further testimonials from Drs. Frankland and Crooks, showing the great practical value of this invention, will be shortly published.

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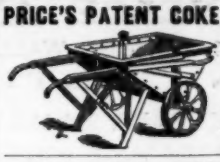

effecting a great saving of time, labour, and expense.

For particulars, price, &c., apply to Mr. E. PRICE, Gas-Works, HAMPTON WICK.

HOPKINS, GILKES, & CO.,
LIMITED,
MIDDLESBOROUGH,
SUPPLY GAS & WATER PIPES of EVERY SIZE.
Plain, Turned and Bored, and Coated.
CAST-IRON RETORTS.
Castings for Gas-Works of every description.
EXHAUSTERS.
LONDON OFFICE: 95, CANNON STREET.

WATER-WORKS FITTINGS,
SLUICE COCKS, FIRE COCKS,
METERS, STEAM FITTINGS,
GAS & HOT-WATER VALVES, &c.,
Of First-class Materials and Workmanship.
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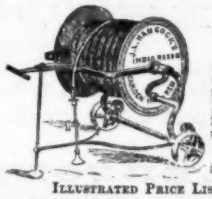
HOSE-PIPES,
FOR WATERING GARDENS, LAWNS, &c.



Made in 60 ft. lengths, and best make only.

Brass branches, with stop-cocks, jets, and spreaders, and union joints for connecting any size Hose. HOSE REELS (galvanized iron or painted) for winding up the Hose.

Orders promptly executed, and
ILLUSTRATED PRICE LISTS ON APPLICATION.

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NAPHTHALINE
IN GASHOLDER INLET-PIPES.

With Livesey's Patent Man-Lid these Pipes can be examined and cleansed without loss of Gas, with the greatest facility and without any risk.

Cost of the Apparatus, to cover two 18-in. pipes, about £10.

Royalty: At the rate of 1s. per foot diameter of each Gasholder, and no further payment.

LIVESEY'S SYSTEM OF WATER-VALVES
FOR PURIFIERS

Will effectually prevent that contamination of the pure Gas which so frequently occurs where the ordinary Valves are used. They are much less costly, easily applied, and, being simple castings, cannot well get out of order, while by their use it is found that the Gas will bear a continuous test for Sulphuretted Hydrogen for an indefinite time.

Application to be made to the Patentee, GEORGE LIVESEY, Engineer, South Metropolitan Gas-Works, S.E., where both inventions are in use.

BIRTLEY IRON WORKS,
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Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

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HIGH-PRESSURE EQUILIBRIUM BALL VALVES
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MANUFACTURE EVERY DESCRIPTION OF
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WROUGHT-IRON
WELDED TUBE AND FITTINGS,
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BRASS, COPPER, LEAD, TIN, AND COMPOSITION TUBING,
STOCKS, TAPS, AND DIES,
And Every Description of Gas-Fitters Tools;
CAST-IRON GAS-MAIN COCKS,
WITH PATENT METAL PLUGS;
GAS SLIDE AND SLUICE VALVES;
CARTER'S SAFETY GAS-VALVES,
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Large Pattern-Book and Price List of Gas-Fittings, price 7s. 6d., supplied on application.

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GAS AND WATER ENGINEERS,

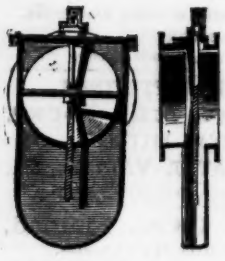
AND

CONTRACTORS FOR GAS AND WATER WORKS APPARATUS.

SHOW-ROOMS AND WHOLESALE WAREHOUSE FOR

Wrought-Iron Tubes & Fittings for Gas, Water, & Steam; Chandeliers, Pendants, Lamps and Brackets, Plumbers Work, Water-Closets, Pumps, &c. Lead, Composition, Brass, and Copper Tubes.

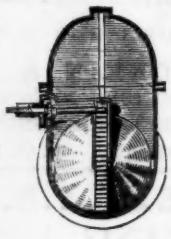
PATENTEES OF THE



NEW FLEXIBLE VALVE

FOR

GAS & WATER WORKS.



This Valve has been designed to meet what has hitherto been felt a great want, in Gas-Works especially—namely, a *really tight* Valve which could be depended upon.

The new Valve is simple in construction, not liable to get out of order, cheap in price, and the principle can be adapted to every part of Gas Apparatus where a Valve is required.

Drawings, Price Lists, and further information sent on application.

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MANUFACTURERS OF

Gas Apparatus, Gasholders, Scrubbers, Condensers, & Purifiers; Iron Main-Pipes, Valves, & Fittings for Gas and Water; Wrought-Iron Retort-Lids; Wrought & Cast Iron Girders, Bridges, Piers, &c.

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GAS-METER MANUFACTURERS,

LONDON ROAD METER-WORKS, EDINBURGH,

SOLE MANUFACTURERS OF

THE PATENT IMPROVED TIN-PLATE DRY METER;

With special facilities for adjusting and repair, the principal parts of the mechanism being accessible by the removal of a single screw.

Gas-Meters on the Wet and Dry principles made in Cast-Iron and Tin-Plate Cases.

Station-Meters, Governors, Experimental & Test Meters, Gas Apparatus, &c.

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THE MERSEY WORKS,

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Manufacturers of all descriptions of Gas, Water, and Station Meter, Clock, Timepiece, Tell-Tale, and Log Dials, Lettered Addresses, Number Plates, Gauges, Scales, &c.

Superior Articles at reasonable prices.

THOMAS CARR & SON,

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FIRE-BRICKS, LUMPS, TILES, RETORTS, &c., &c.,

SCOTSWOOD FIRE-BRICK WORKS,

NEAR

BLAYDON-ON-TYNE.

B. CARPENTER'S

IMPROVED

WOOD SIEVES FOR GAS PURIFIERS.

WORKS:

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The above Sieves are used by the principal Gas Companies in London and the country. Their utility, durability, and cheapness combined, render them superior to all others.

Testimonials from Gas Engineers who have tested their qualities forwarded on application.

All orders punctually attended to, and estimates given if required.

Established 1811.

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MANUFACTURERS OF

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And every Description of

GAS-FITTINGS,

Including

MEDIÆVAL FITTINGS FOR CHURCHES, &c

Large Pattern-Books complete, with Book of Prices, 7s. 6d.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 42, Parliament Street, WESTMINSTER. [Office of the JOURNAL OF GAS LIGHTING, &c.]

CARD.

D. BRUCE PEEBLES,

While thanking his numerous friends and customers for the liberal patronage they have hitherto bestowed upon him, begs to state that the business at Fountainbridge Works will in future be carried on under the firm of D. BRUCE PEEBLES & COMPANY.

With reference to the above, D. BRUCE PEEBLES & COMPANY beg to intimate that, in order to meet the growing requirements of their increasing business in Gas-Meters and Gas Apparatus generally, they are building large additions to their premises. The demand for the

PATENT TIN-CASED WET AND DRY METERS,

WITH TONGUE & GROOVE JOINT,

Has hitherto exceeded the capabilities of supply; but with a large addition to their Works, and the introduction of special tools, they hope soon to be able to execute orders from stock with punctuality and despatch, and to merit a continuance of the support which has so liberally been given to Mr. Peebles.

D. BRUCE PEEBLES & COMPANY,

ENGINEERS, WET AND DRY GAS-METER MANUFACTURERS,

BRASS FOUNDERS, & GAS APPARATUS MAKERS,

FOUNTAINBRIDGE WORKS, EDINBURGH.

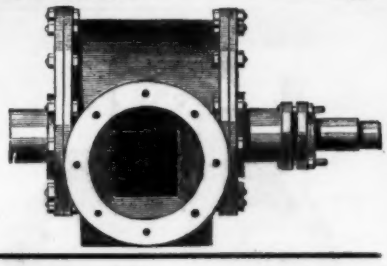
ROTATORY AND DOUBLE-ACTING GAS-EXHAUSTERS,

With many recent improvements, from 1500 to 150,000 cubic feet per Hour.

JAMES BURTON, SONS, & WALLER,

MAKERS OF ENGINES, MACHINERY, and IRONWORK for GAS-WORKS,
Efficient and durable TAR, LIQUOR, and SYPHON PUMPS,
GAS-VALVES, with or without Wedges, worked with powerful Worm and Rack,
SELF-ACTING BY-PASS VALVES, with Lid and Relieving Lever,
ROTATORY, TUMBLER, and CAPILLARY WATER DISTRIBUTORS for SCRUBBERS.
SMALL-SIZE EXHAUSTERS KEPT IN STOCK.

JOHN'S PLACE, HOLLAND STREET, SOUTHWARK, LONDON, S.E.



KING BROTHERS,

STOURBRIDGE FIRE-BRICK AND RETORT WORKS.

KING BROTHERS beg especially to call the attention of Gas Companies to the superiority of their Retorts, which are made from the celebrated STOURBRIDGE FIRE-CLAY. Mr. King has patented a Kiln for burning Retorts, by which Patent all Cold Air is excluded from the Kiln while burning, thus rendering them FREE FROM CRACKS AND CORRECT IN FORM. By great care in Manufacturing, combined with the advantages in burning, a VERY SMOOTH SURFACE is obtained, rendering them less liable to carbonize.

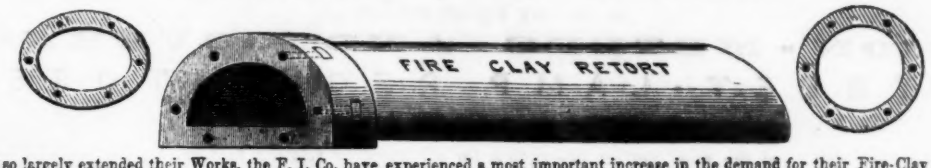
Retort Ovens, Fire-Bricks, Guards, Saddles, Rabbitted Bars, Flues, and Quarries, are all Manufactured of the same quality of Clay.

Every Retort and Brick is branded "King Brothers, Stourbridge."

Agent in Ireland—Mr. JAMES FURNESS, No. 3, FOWNES STREET, DUBLIN.

THE FARNLEY IRON COMPANY,

FARNLEY, near LEEDS.



Since they so largely extended their Works, the F. I. Co. have experienced a most important increase in the demand for their Fire-Clay Retorts, which they owe chiefly to the superior quality of their make, and to the facilities they now possess for executing orders promptly, either for *home* or for *export*.

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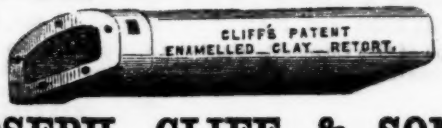

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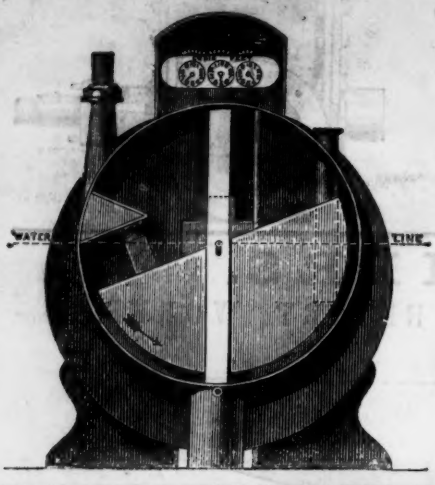

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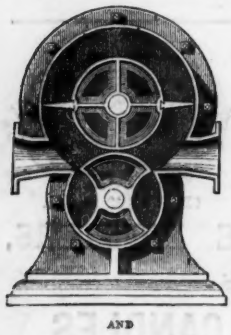

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